ORWELL ASTRONOMICAL SOCIETY (IPSWICH)

O.A.S.I.

SOCIETY NEWS

1. **Dome out of use**
   The observatory will be out of use for the next few weeks until essential repairs have been completed. The track supporting the dome has been showing signs of cracking for many years. It has finally broken completely through, to the right of the shutter step. This has caused a knock on effect, with the shutter rail dropping, thus making the opening and shutting very tricky. Repairs will be undertaken on Wednesday evenings for how ever long it takes.
2. **Open Evenings**
   Our annual open evenings will be between Friday and Monday the 19th to 22nd September from 8.00 p.m.
   As is usual at such events as much help as possible will be required to run these events.
3. **F.A.S. Convention, Herstmonceux**
   The annual F.A.S. Convention at Herstmonceux will be on Saturday 4th October. This will probably be the last such convention to be held here as there are plans to move the R.G.O. to Cambridge. Costs will include an entrance and transport fee. Interested members should contact Roy Gooding.
4. **Committee Meeting**
   The next committee meeting will be on Saturday, 6th September in the club room at 7.30. The meeting is open to all members.

NIGHT SKY

(all times G.M.T.)

Sun — Rises approximately between 04.20 - 05.10
Sets approximately between 20.00 - 19.00

Moon — ● 5th ◐ 13th ○ 19th ◑ 27th

Mercury — Visible in morning sky at Mag. 0.0 Greatest elongation of 19° on the 11th. Rises about $1\frac{1}{2}$ hours before the sun on the 11th.

Venus — Bright evening object Mag. -4.3. Greatest eastern elongation of 46° on the 27th. Sets less than an hour after the sun.

Mars	Sets at midnight in mid month. Mag. -2.0.
Jupiter	Rises just after sunset. Mag. -2.8. Prominent in S.E. sky.
Saturn	Sets at about 22.30 in mid month. Mag. 0.5.
Uranus	Sets at about 23.00 in mid month. Mag. 5.8.
Neptune	Sets at about 23.00 in mid month. Mag. 7.7.

R. Gooding.

ASTRONOMICAL TERMS

E SIMS

DARK NEBULA

A Dark Nebula is a cloud of gas and smallsolid particles in which the dust particles absorb and scatter light from stars lying beyond the cloud. The cloud therfore appears as a dark patch against the starry background.

The mean density of dust particles in these clouds is very low, but in volume they may contain many times the mass of the Sun in the form of absorbing material.

One of the best-known examples of a Dark Nebula is the 'Coal Sack', this is a dark patch in the Milky Way and is clearly visible to the nakid eye near the Southern Cross. This cloud is about 25 light years in diameter and contains about 15 Solar masses in the form of absorbing material.

DOUBLE STAR

A Double Star is a pair of stars that appear to be close together in the sky. There are two types, optical doubles and binaries. Anoptical double is made up of two stars which appear to be close together only because they happen to lie in almost the same direction as seen from the Earth. The individual stars may lie at very different distances from the Earth and not form a physically linked system.

A binary consists of two stars which are close together and move round there common centre of mass subject to their mutual gravitational attraction.

SOLAR FLARES

Solar Flares are sudden short-lived outbursts of light sometimes seen in the vicinity of the Sun spot groups. They are thought to originate from a build up of gas flowing out along the lines of force of the magnetic field associated with Sun Spots.When the gas builds up such a pressure that it cannot be contained by the Magnetic Field it erupts outwards as a bright filament accompanied by a shock wave spreading over the Solar surface.

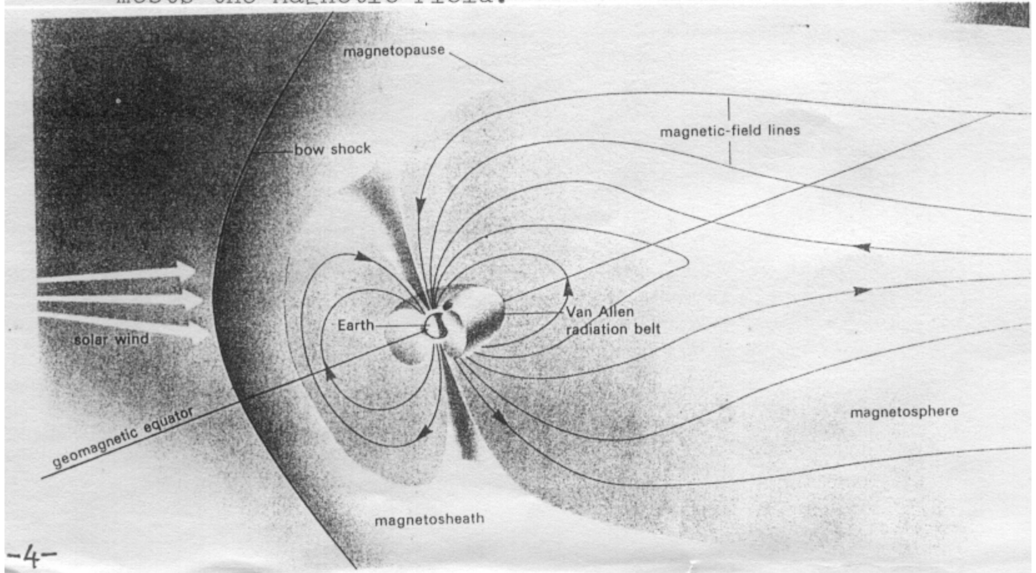
Flares are classified according to brightness, and the brightest Class 3 flares cause appreciable effects on Earths atmosphere. Charged particles released from flares reach Earth in about two days, disturbing the Ionosphere and give rise to Auroral displays. Flares are also responsible for the emission of a variety of radiations, from X-rays to Radio Waves.

MAGNETOSPHERE

The Magnetosphere is the region around a Planet within which its magnetic field is dominant.

In the case of the Earth the Magnetosphere is shaped like a tear drop extending on the Sunward side about 10 Earth radii and much further on the side away from the Sun. This shape is the direct result of the interaction between the Solar Wind and the Earths Magnetic Field.

Tre boundry of the Magnetosphere is called the Magnetopause, beyond which lies the Shock front which is like the bow wave of a ship, where the Solar Wind meets the Magnetic Field.



MR. SCHMIDT AND HIS CAMERA by Mike Harlow

PART 3: BUILDING A SCHMIDT CAMERA

The Schmidt camera is idealy suited to photographing large, faint objects, for example, objects like the Orion, North America and California nebulae, M31, M33 and of course, comets. Shots of star fields in the Milky Way are also impressive showing maybe 10,000 stars on one negative!
The first decision is: what size of camera do I want? There are several considerations here, the most important being; i) size of the finished instrument, ii) photographic speed, iii) field of view. The question of size should be considered seriously, remember that the camera must be mounted on an equatorial and driven to follow the stars for up to maybe 30 minutes. Photographic speed determines the maximum exposure because if the camera is very fast, say f/1 or f/1.5 then the background sky fog will severely limit exposures. The field of view is also determined to some extent by photographic speed, between f/2 and f/3 the field will be about 10^{o} to 5^{o}; this is a good range being intermediate between ordinary SLR camera lenses and telescopes. When everything is considered a camera with a 6 inch corrector plate and a speed of about f/2.5 is a good general purpose instrument to build.

The Primary Mirror

As mentioned in part 2 the mirror is always larger than the corrector in order to collect light from a wide field. For a 6 inch corrector an 8.5 to 9 inch mirror is ideal. The details of mirror making are too involved to go into here but there are several books, listed at the end, which describe the methods involved. The conventional method is to use two discs of equal size, one of which becomes the mirror the other being the tool. For Schmidt primaries however it is quicker to use a smaller diameter disc as the tool as the curves required are very deep. For my mirror of 8.75 inches I used a 4 inch tool. After grinding, polishing should idealy be carried out with a full sized polisher, however, having used a small tool there is no full sized disc with the required curve on it. I overcame this problem by casting a resin plastic disc in the curve of the mirror (coated with grease to prevent adhesion) and then stuck this to a full sized, flat glass disc. The polishing lap was then made in the usual way (see ref. (4)).

The Corrector Plate

When the spherical primary mirror is complete and its radius of curvature has been accurately measured the shape of the corrector can be calculated. The equation describing the curve is:

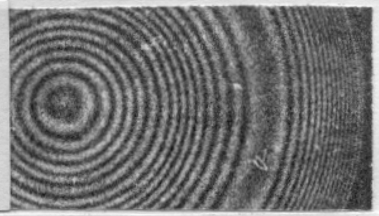
$$\Delta = k(x^4 - Ar^2x^2)/4(\varepsilon - 1)R^3$$

where Δ is its deviation from flat, x is the radius of the zone being considered, r is the clear radius of the plate, ε is the refractive index of

the glass and R is the mirrors radius of curvature. There are two constants; k is either 0.5 if equal curves are put on both sides or 1 if all the correction is on one side, the other being flat. The constant A which is usually either 1 or 1.5 determines the overall shape.
The problem with optical work is devising a test to show that the shape is the one required. The test I devised for the corrector involves placing it in contact with an optical flat and measuring the interference fringes produced with monochromatic light. The air gap between corrector and flat is given by the equation above. By manipulating this equation it is possible to predict, for the completed plate, where the bright interference fringes should appear. The positions, x, for bright fringes are given by,

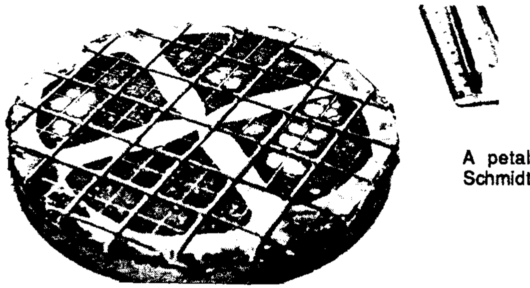
$$x^2 = (Ar^2 \pm (A^2r^4 - 2(n + 1/2)K\lambda)^{0.5})/2$$

where n are integers, 0,1,2,3..., K is $8(\varepsilon - 1)R^3$ and assumes that k = 0.5. i.e. equal curves on both sides. The wavelength of the monochromatic light is λ.
The x positions for the completed corrector are compared to those measured during the figuring of the plate to check on progress. Full details of the test are given in ref. (5)., and the interference pattern for my corrector is shown in the photo below.



Interference pattern from centre to edge of a six inch Schmidt corrector on an optical flat illuminated with a Helium-Neon laser. λ = 632.8 nanometers.

Armed with this test the plate can be started. I bought a suitable disc of optical glass from H.V.Skan Ltd. (address at the end). The first thing to do is grind both sides flat and parallel which can be done using the methods for making optical flats (see books), i.e. using two other discs and grinding in pairs in the sequence 1 on 2, 2 on 1, 1 on 3, and so on. The sides are checked to see if they are parallel by measuring the thickness around the plate with a micrometer. When the plate is finished it should ideally be the same thickness round the edge to within a few microns.
Polishing is initially carried out to obtain a flat surface on both sides which will give straight interference lines; only then should the Schmidt curve be started.
Figuring the curve is achieved using a *graded* polisher: one I used is shown below. The petal shapes are calculted from the shape of the Schmidt curve; the amount of polishing action at a particular zone should be proportional to the depth of the curve. The polishing action has very short strokes across the centre of the plate and is called *drag polishing.* Regular checks with the interference test indicate how the work is going; final stages of figuring may involve only 1 or 2 minutes work between each test to achieve the required accuracy.



A petal shaped polishing lap for figuring a Schmidt corrector plate.

And The Rest

As mentioned in part 2 the focal surface of a Schmidt is curved towards the mirror, the radius of curvature being half that of the mirror. To make the curved surface I used the same technique as I had to make the full sized tool for a polisher. I ground a glass disc to the correct curvature and used it as a mould to cast a convex resin plastic disc. The plastic resin is available from model shops and is the type used for making plastic chess pieces etc. from rubber moulds. The curved surface can be smoothed by fine grinding on the concave glass template.
This gives the focal surface to which discs of cut film can be sprung loaded using a retaining ring and springs. Full details of the film holder would take up too much space, but if you have got this far the remainder is fairly straightforward.
Problems that remain which have to be overcome before the first photos can be taken are, for example, how to cut discs of film and subsequently load them into the camera in complete darkness?, how to align the optics and focus the camera? and several others. These will have to be left to the individual although the references give many helpful ideas.

Conclusion

This series of three articles has neccessarily been brief and the intention, certainly of part 3, has been more to stimulate interest than provide detailed accounts of every step. Anybody requiring more information can contact the author most Wednesdays at the observatory or at the address on the back page. **Also, the references below give all the information neccessary to make a start in telescope making at any level.**

References

Books
1) Amateur Telescope Making. 3 Volumes. Ed. A. G. Ingalls, Published by Scientific American.
2) How to Make a Telescope. by J. Texereau. Published by Willmann-Bell
3) Master Optical Techniques. by A. S. DeVany. Published by John Wiley

Magazine Articles
4) Sky & Telescope, Vol. 66, page 454, 1983---Making polishing laps.
5) Telescope Making #27, page 28, Spring 1986---Intereference test for Schmidt correctors.

Supplier of Optical Glass
H.V. Skan Ltd., 425 - 433 Stratford Road, Shirley, Solihull, West Midlands, B90 4A

A HISTORY OF ASTRONOMY PART 6

Neil Taylor.

Stonehenge.

Many legends are associated with the collection of standing stones on Salisbury plain known as Stonehenge Could it be that such a structure was constructed to trap many devils which haunted the land? many other smaller circles had been made for this very purpose.
The earliest recorded writings about Stonehenge date from the 12th century,when the chronicler Wace told us the origin of the name Stonehenge came from the French for'hanging stones',Stanhengues. This invoked the popular misconception in the middle ages that the place was a site of public execution. Many stories were told by monk Geoffrey of Monmouth of the connection between Stonehenge and the Arthurian legends. After a deed of infamous treachery against Arthur when many of his noble knights had been slain, Arthur resolved to build a tribute to his dead. Merlin suggested that a stone monument in Ireland which had been made by giants carrying stones from Africa would be a suitable tribute.
An expedition was mounted, and the great stones were wrested from the Irish and rebuilt near the edges of the marshes of Avalon. Merlin however could not forsee the perils of the future that these stones would bring.
Although Merlinwas the greatest of all Wizards, yet there remained a mgic greater than his, a magic with roots before time its' very self, a magic contained by the stones. Merlin became entomed within the "Slaughter" stone by the lady of the Lake, Nimut, and dire consequences rest upon whoever lifts up the stone. On a perhaps more realistic association of Merlin with Stonehenge may lie in the interpretation of the name "Merlin" as being a corruption of the name of the Celtic sky god "Myrddin", giving support to the idea of Stonehenge as an ancient Celtic temple.
The earliest archaeological studies into Stonehenge are thought to be those of John Aubrey, who discovered the 56 holes now known as the Aubrey holes. Aubley was convinced that Stonehenge was a very ancient Druidic temple, although this theory is highly questionable as the druids came long after the construction of the place 1740 saw William Stuckley observe that the main avenue of Stonehenge towards the heel stone lay in the direction

of the rise of the sun on mid-summers day. The druid Cubit, a measurment of 20.8 inches, was suggested in Stuckley's work "Stonehenge a temple restored to the British druids" which again supported the erroneous Druid theory.

Norman Lockyer's study of 1901 concluded that as viewed from the centre the Heel stone has never coincided with the mid-summer sunrise, although this would depend on how sunrise is defined.

Looking at Stonehenge itself archaeology has told us there has been 3 phases of building known as I, II, and III. The most impressive central structure , the Trilithon stones were placed during Stonehenge III probabley near 1700 B.C. Stonehnge I consisted of a large 300 foot diameter circular ditch and bank approx 8 feet high. It is strange that the ditch appeared to be not maintained at all and was used in fact for debrid from the builders. The ditch was broken towards the north-east along the avenue leading to the heel stone, another Stonehenge I product. A piece of antler bone found within the ditch has been radio-carbon dated and suggests stonehenge I construction occured near 2700 B.C. Perhaps the most mystic construction of this age were the Aubrey holes, the 56 holes which appear to have been dug and then immediately filled in again. It appears as though fires had beem lit in the holes and crematorial remains have been found within, hence suggesting some religious rite. The purpose of these holes are still unclear though Gerald Hawkins published a theory on the subject in 1963. Appart from the Aubrey holes there are several other stones present in the bank and the four "postholes" outside the circular bank near the heel stone date from this age. Stonehenge II accounts for waht are known as the "bluestones" and the "sarsen stones". The bluestones form part of a circumference of a circle inside the bank, the spacing of the stones suggest that if all the circle was complete that there would be 19 bluestones, which is a significant number in astronamy as we will see later.

The bluestones were then knocked over and replaced by 81 sarsen stones this age dates back to about 1750B.C. Stonehenge III the last phase of building dates from around 1700 B.C and it was in this phase that the most impressive structures were built including the huge "trilithon" stones which dominate the monument.

An Astronomical Observatory?

The sun rises at different points on the horizon on different days of the year and in the northern hemisphere rises most to the north on midsummers day and most to the south on midwinters day. At the latitiude of stonehenge the difference between these points is about 80 degrees. In a similar way so does the position of moon rise vary throughout the month with the difference between it's most northerly and southerly rise being variable from 60 to 100 degrees at maximum.

In 1963 Dr. Gerals Hawkins found using an IBM Computer that the extreme yearly directions of sunrise and monthly directions of the moonrise were accurately reproduced by alingments of the stones. Further investigation led him to the conclusion that using only the major Stonehenge III stones the maximum number of significant alingments possible with that number of stones had been achieved to within a small error margin. Many such alingments have been found in the stones of Stonehenge I and II though not the same accuracy as Stonehenge III suggesting that the final phase of building was the culmination of the building The alingment properties only work at the stonehenge site. Of all the constructions at Stonehenge perhaps the most intriguing are the Aubrey holes dug during the StonehengeI period, a total of 56 stones wheih may have been used as as indicator of the 18.61 cycle of lunar nodes known as the Saros (56/3=18.67). Hawkins thus suggested the holes were a counting device to aid Eclipse prediction. Merely by observing the saros would not lead to the prediction of all eclipses and a more complex method would need to be employed.

THE END.

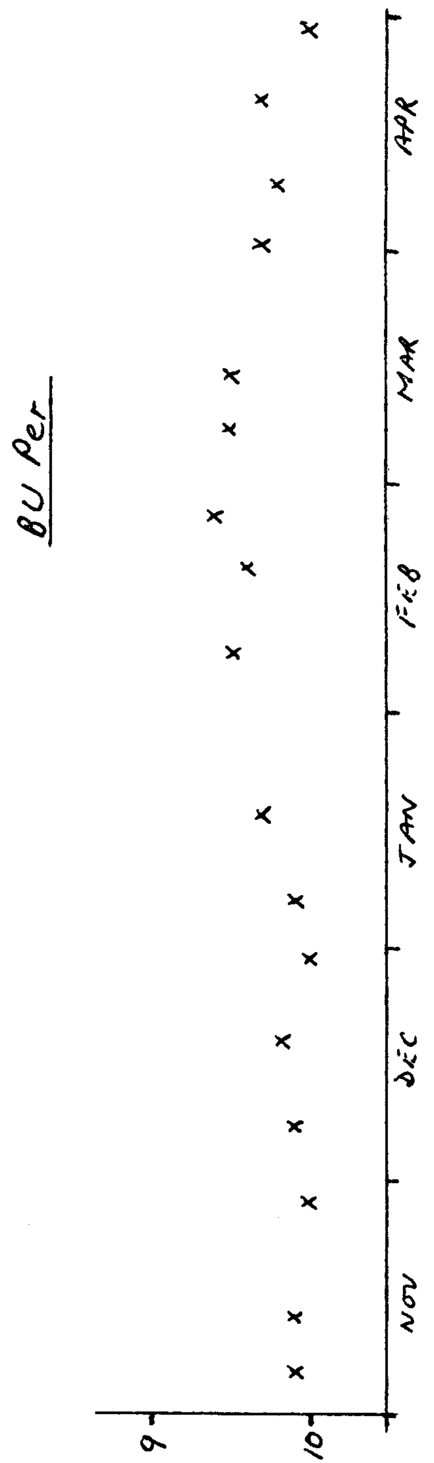
VARIABLE STARS

by Mike Nicholls

This light curve shows BU Persei from November 1985 to April 1986. It can be seen that this star does vary, but its magnitude range is not very large. It has been known to reach magnitude 7.9 in the past, but the small range is typical of the class of semi-regular variables to which it belongs. It is an old red giant star and variations are believed to be caused by pulsations of the atmosphere. A period of these pulsations is difficult to establish because they are not very regular, as the name of the class suggests, however, 365 days has been suggested as a rough figure.

BU Persei is to be found in the double cluster of the sword handle and is thought to be a possible member.

All observations were made using an 8" reflector.



PROGRAMME FOR AUGUST

DOME CLOSED FOR REPAIRS ON BROKEN TRACK

Wednesday Night retained for urgent repairs.

HELP NEEDED

WEDNESDAYS from 8pm 6, 13, 20, 27 — NEBULEA & FAINT OBJECTS SECTION
Mr M Cook, [redacted], Ipswich — Tel: Ips. [redacted]
Mr D Payne, [redacted], Wickham Market. — Tel:W.Mkt [redacted]

1986 COMMITTEE

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F.A.S. ARTICLES	M Harlow	[redacted], Felixstowe	Home: [redacted]