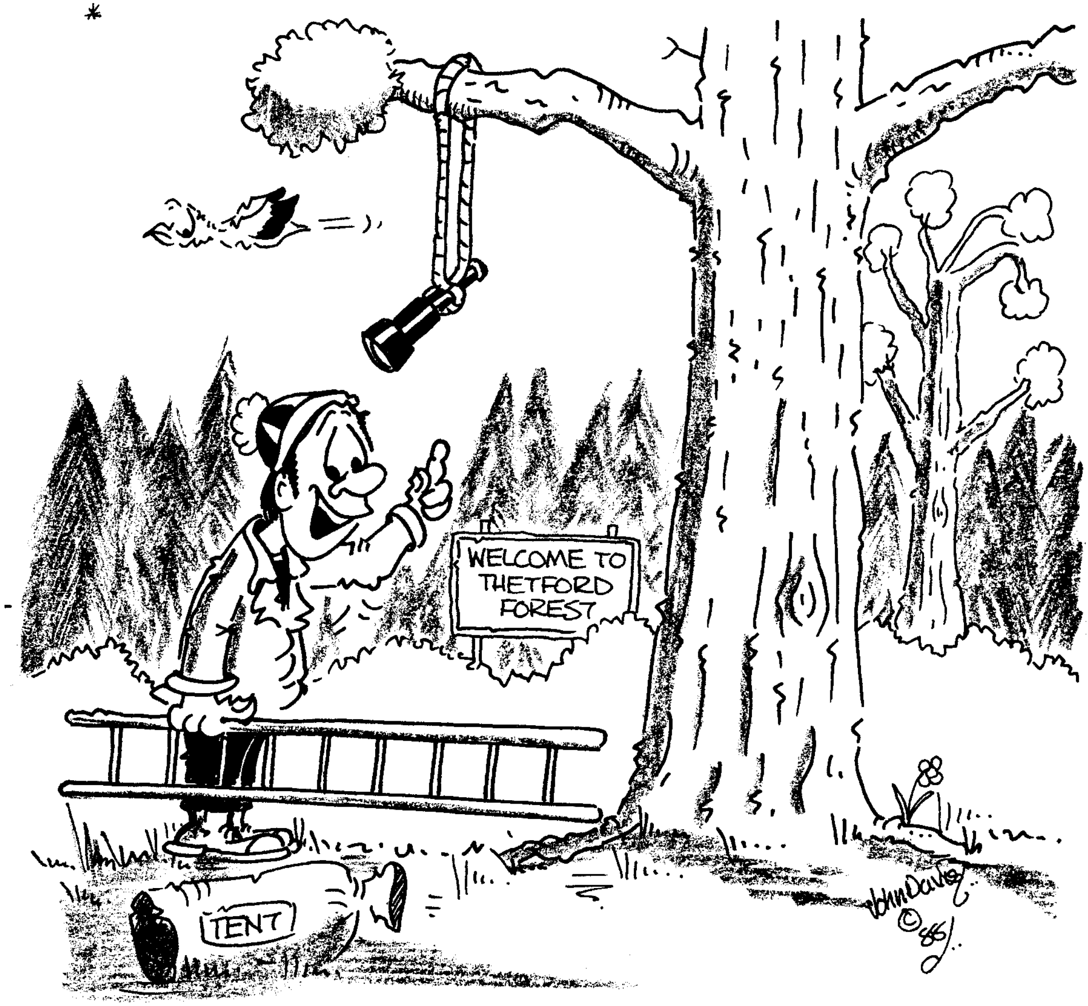
ORWELL ASTRONOMICAL SOCIETY IPSWICH

O.A.S.I.



I MUST ADMIT I'VE NEVER HEARD OF A SKY CAMP .... BUT I'LL TRY ANYTHING ONCE!

APRIL 1988

SOCIETY NEWS

1. <u>21st Anniversary Open Day, Saturday, 9th July</u>

This event will require a considerable commitment for <u>ALL</u>! members. EVERY ONES HELP will be needed.

If you can help please contact any committee member. The list can be found on the back page.

The programme for the day is now being finalised. The following is a provisional programme:-

10.30 Doors open, observatory open
10.45 Observatory, guided tour
11.00 and on each subsequent hour, Video films. ?
11.00 Continuous slide show
11.30- 12.30 Lecture by Neil Bone on 'Aurora'
12.30 - 14.00 Lunch break
13.15 and on each ¼ hour, observatory guided tour
14.00 - 15.00 Lecture by Professor Stuart Malin 'The Road to 1984'
15.00 - 16.00 Afternoon break
16.00 - 17.00 Lecture pending
17.00 Raffle results
17.00 - 18.00 Possible evening lecture
20.00 Close

NIGHT SKY

(All times G.M.T.)

Sun	Rises from 05.40 to 04.30 Sets from 18.30 to 19.30
Moon	○ 2nd ◐ 9th ● 16th ◑ 23rd
Mercury	Superior conjunction on the 20th. May be seen in the evening sky at the end of the month.
Venus	Greatest eastern elongation (46°) on the 3rd, sets about 4 hours after the sun in mid month Mag.-4.4
Mars	Rises between 03.10 to 02.10 Mag. 0.4
Jupiter	Sets at 20.10 in mid month Mag.-2.0
Saturn	Rises between 01.30 to 23.30 during month Mag. 0.4
Uranus	Rises between 01.30 to 23.30 during month Mag. 5.9
Neptune	Rises between 02.30 to 00.10 during month Mag. 7.7

The Sanduliac-69202 Adventure- Discovery Of And Research Into A Supernova from 'Horizon', 1988 January 11 (BBC 2). 'The Death of a Star' as retold by Roy Adams

Continued from last month

The scene therefore moves to what is believed to be the most sensitive neutrino detector yet built, deep in a zinc mine in Western Japan, at Kamioka. Yasuwa Totsuka ((please forgive if the spelling is ever found wrong)) and American collaborator, Al Mann there are in charge of an enormous tank of pure water four storeys high, around the sides of which are 948 very big photomultipliers, covering 20% of the tank's surface area. Being so deep beneath the rock, other radiations are screened-off, but the neutrinos can penetrate all the covering rock (and a lot more). In fact, for sensing the neutrinos from -69 202, the neutrinos would have had to pass through a few thousand miles of Earth-mass and been on their way out again into space.

The hope in using such detectors as the one at Kamioka, is that a few neutrinos will collide with respective electrons in the water, as a result producing a sort of 'bow-wave' of what is known as Cherenkov radiation, due to the electron being accelerated. The 'bow-wave' is detected as a circle of blue light by whichever of the photomultipliers is reached by the dissipating cone - signals from many multipliers in a ring shape at a particular instant, being translatable from tape recording apparatus. The photomultipliers are in tube form, designed by a Professor Koshiba, and are believed to be the largest in the world. A computer feeds the signals from the tubes to the magnetic tapes. Those for 1987 February 23rd were sought out.

Almost a day before Ian Shelton noticed the supernova, a sharp spike in the signals had been recorded - eleven out of the billions of neutrinos passing through the tank had been involved in collisions with electrons and been recorded from the explosion 170 000 light years away. The team had been lucky: Every hour, the system is turned-off for 105 seconds for recalibration. The neutrino burst occurred over only 13 seconds, and had it come two minutes later, it could have been passing in the 'off' period! The 3 000 tons of water would have been for nothing in this particular avenue of research! Al Mann had spent 40 years in the business. He could've missed it.

Another test of theory was concerned with the idea that blue stars like Sanduliac are too young and dense to explode. Sanduliac's recent behaviour had been unusual from the start. Rob McNought, a young Scotsman working for the University of Aston in Birmingham (England) taking photographs of Earth-orbiting satellites using an old Schmidt telescope at Siding Spring Observatory, where Graham White also worked as already mentioned, now enters the arena. He is a keen amateur astronomer in his spare time, using a camera to search for strange objects such as stars nearly every night. He had been out taking pictures of the Large Magellanic Cloud on February 23rd, but had not developed his work before going to bed. It turned out he had the first picture of the explosion of the star.

He feels sorry that the evidence he had, had not been worked on and reported earlier - it would have helped others to know and immediately concentrate on getting spectra in the earliest possible stages of the explosion.

McNought's picture taken within three hours of the neutrino shower showed that this supernova had brightened immensely in that time ((assuming the neutrinos travelled at the same velocity as the visible light)). Previous supernovae had shown a regular pattern of taking days rather than hours to brighten. But then the light of the new supernova suddenly stopped brightening, whilst still ten times dimmer than it would be if it was a normal, red star that had gone supernova, Type 2, which can take weeks to reach visual maximum. Red supergiants are thousands of times brighter than the Sun and about 250 times larger in diameter. Sanduliac had been as bright as one of these red supergiants, but being a blue one, it was only one tenth the diameter of a red one.

Being much denser, more energy of the explosion was needed for its expansion, leaving less energy to be evidenced as light. In order to reach a similar density level as an exploding red giant star, for given light 'layers' to be seeable, more work has to be done by the system getting to that state, so the blue supergiant explosion appears fainter. The velocities are also higher so the brightness plateau is reached sooner than for a red supergiant's explosion. Matter had gone into space at as much as 50 000 000 mph.

To see what was left behind, as well as the expanding remnant layers, NASA's deep-space radio telescope at Canberra was brought into play, although the operators were caught somewhat unprepared. Radio telescopes can reveal more detail than optical telescopes in cases like this, by linking two of them thousands of miles apart to effectively gain the radio resolution of one telescope the same width as their distance apart. David Johntsey and his colleagues at Canberra decided to link their Australian radio dishes with one in South Africa, 5 000 miles away. In doing this, they had to be sure precisely the same radio frequencies were used in each. In the haste, they nearly slipped-up over this. After sending the record tapes from the respective stations to Bob Preston in the USA, it seemed for a while that 'synch' hadn't been made, registration being 2 MHz off. When informed of this, David really felt bad. He had a very restless night.

Then came inspiration: just move one set of signals down the width of one recording channel, and with a bit of modification, the data should be totally recoverable by the correlators in the States. David slept again!

Really, Sanduliac's extent had increased so fast that it was now too large for the telescopes to see in full. The initial burst of radio signals then disappeared. Dust and gas had obscured them. But as the months went on, it was expected that the signals would reappear. David Johntsey at Canberra with a smaller, VLBI array and other folk at Molonglo ((which I presume is the South African telescope site)) are meanwhile checking two or three times weekly for the reappearance, hoping eventually to map the continuing expansion of the supernova.

By May, 1987, much routine observation had been fed into the databanks around the world, but then came another new discovery, made at Cerro Tololo Observatory in Chile, just 100 miles south of where the original discovery of the supernova was made. Two scientists from Harvard University, Costas Papallerlios and Peter Niesensen had arrived there in March, eager to carry out a delicate experiment in speckled interferometry, at which they were experts. They hoped to combine thousands of images of the object to see what was happening in the expanding shell, using a computer to iron out irregularities caused by the Earth's atmosphere. At the end of May, Peter returned to Tullola with the news that a new object in the field of the supernova had been revealed by their work. This object was as much as one-tenth of the brightness of the supernova with characteristics of a double star, a close double. It was 100 times brighter than Sanduliac or other nearby stars. But what was it? Indeed, what IS it?!

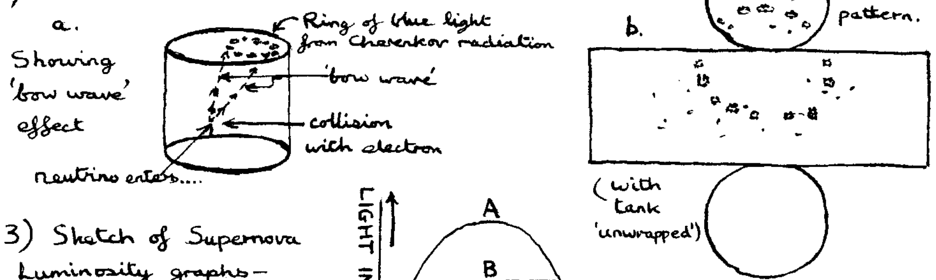
The indications given by Peter and Costas' technique of collecting up signals even from individual photons in a computer, and noticing relatively dark and light lines in the final summation and their degree of separation were clearly of a new object connected with the supernova. Various suggestions were put forward - anything from a black hole, to another supernova. Throughout August, there were arguments as to whether the new object was still there, however.

British observers, meanwhile, detected X-rays of increasing intensity. These could have come from radioactive core decay or radiation from a hot, young pulsar. Theorists came in with their predictions: a neutron star? It could not be a black hole at only 1.3 solar masses. Is it rotating fast enough to be a pulsar? Does it have a strong magnetic field? If so, we should know in about a year. We may be able to see pulsed emissions, x- and gamma-rays additional to those produced by radioactivity. But then again, perhaps what we see will give rise to even further questions and controversy ...

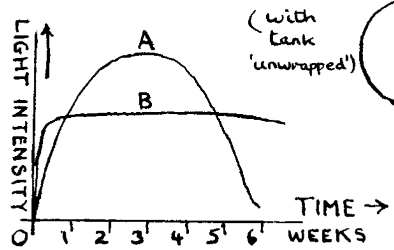
((Incidentally, I see there is enormous disparity of figures about megatonnage of the explosion of supernovae typically and of the Sanduliac event as respectively mentioned in a literary source reference and the programme. The literary source suggests 10^{51} ergs for the supernova explosion making the Crab Nebula. So we might expect Sanduliac to have exploded with a similar order of energy release. As the book says a 1 megaton explosion equals about 10^{23} ergs, we could perhaps expect a megatonnage of 10^{28} rather than only 10^{20} megatons as said by someone on the programme - I can't remember exactly who, but I know I got the figure right!))

DIAGRAMS

2) The Neutrino Detector Tank.



3) Sketch of Supernova Luminosity graphs –
A Example red supergiant progenitor
B Sanduliac –69 202



Roy Adams

XWORD No.13

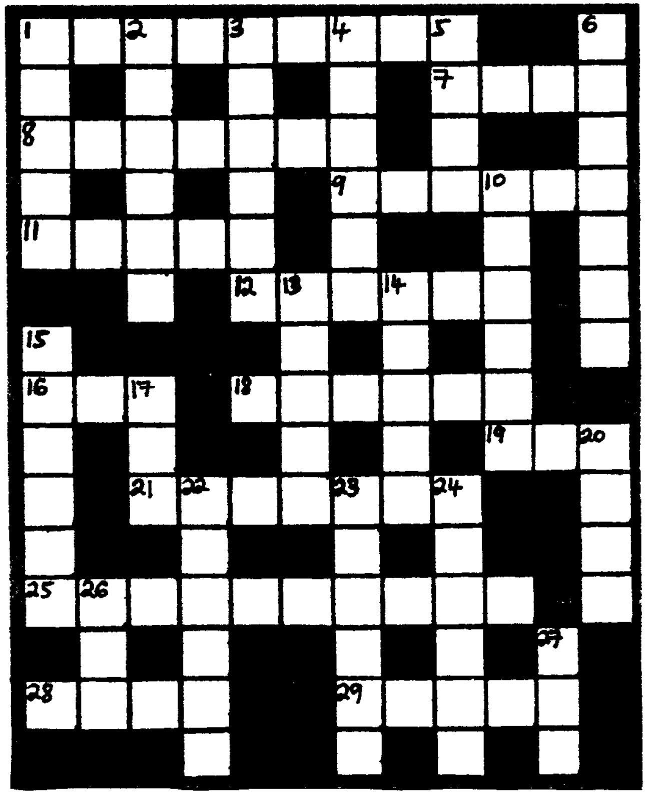
ACROSS

1 Study of the universe considered as a whole (9)
7 Minor planet with lovely name (4)
8 Day is very much hotter than night on this planet (7)
9 Deep red star in constellation Cepheus (6)
11 Hind paws of the bear - see Ursa Major (5)
12 American lunar probes which crash landed on the lunar surface (1961-65) (6)
16 Star in Canis Major which has a companion "pup" (4)
18 Measurement of an object's reflecting power (6)
19 Phase of moon which is only visible during a solar eclipse (3)
21 Four periods of time astronomically defined by different positions of the sun with respect to the equator (7)
25 Point at which a star is in Zenith (10)
28 Movable hemispherical roof of an astronomical observatory (4)
29 X1V moon of Jupiter (5)

DOWN

1 It moves in a very elongated orbit (5)
2 Season between Vernal equinox (21st March) and summer solstice (22nd June) (6)
3 Eyepiece of an optical instrument (6)
4 Astronomical gas essential to life as we know it (6)
5 In general terms, time required for the Earth to complete one revolution of the sun (4)
6 An element distinguished by the nuclear mass of it's atoms (7)
10 Ye olde favourite star atlas (6)
13 One of the brighter stars in the Pleiades - named after the legendary father of the "seven sisters" (5)
14 First US man in orbit (5)
15 Asteroid, discovered in 1936 (6)
17 Highly rarefied matter (3)
20 Lupus - constellation (4)
22 Religious holiday defined by the phase of the moon (6)
23 Flattened out at the poles of a sphere (6)
24 Constellation Libra (6)
26 The serious observer may have seen one of these - 3 letter acronym (3)
27 Condensed atmospheric vapour which can be a nuisance to observation (3)

XWORD No 13



Solution to crossword number 12

Across 1 Apollo, 4 Pegasus, 8 Pictor, 9 Algol, 10 Altair, 12 Cataclysmic, 14 Elara, 15 Nutation, 18 Ophiuchus, 20 Amor, 21 Prime, 22 Atomic, 23 Interstellar, 24 M31

Down 1 Alpha Centauri, 2 Occultation, 3 Lyot, 4 Pallas, 5 Star, 6 Sagitta, 7 Bull, 11 Alioth, 13 Parsec, 14 Equator, 16 Icarus, 17 Normae, 19 Homam

Calculating Altitude and Azimuth

D B Payne

This article follows on from the november 1987 article 'Computing Sidereal Time' and shows how to calculate the altitude and azimuth of an object knowing the right ascension, declination and the local sidereal time. The altitude and azimuth of an object gives an observer a direct indication of its suitability for observing from his local site at a particular time. The ability to calculate altitude and azimuth can mean optimally planned observing programs particularly when observing from a site with restricted views of the horizon.

The altitude - azimuth coordinate system, also known as the horizon system, is based on the 'astronomical horizon' projected onto the celestial sphere. The astronomical horizon is a great circle projected onto the infinite celestial sphere with the axis passing through the observer and the centre of the earth. Azimuth is usually measured westwards (clockwise looking down at the Earth) from the south point on the horizon so that west is 90°, north is 180°, east is 270° and south is 360° or 0°. Altitude is measured from the horizon to the zenith (0° to +90°) and from the horizon to the nadir (0° to -90°), the zenith is the point vertically overhead and the nadir is the point directly below passing through the centre of the Earth.

The relationship between altitude/azimuth and RA/Dec is given by the following equations:

$$\mathrm{Cos(al)Cos(az)} = \mathrm{Cos(la)Sin(dec)} + \mathrm{Sin(la)Cos(dec)Cos(h)} \quad ..1$$

$$\mathrm{Cos(al)Sin(az)} = \mathrm{Cos(dec)Sin(h)} \quad ..2$$

$$\mathrm{sin(al)} = \mathrm{Sin(la)Sin(dec)} + \mathrm{Cos(dec)Cos(la)cos(h)} \quad ..3$$

Where al = the altitude of the object
az = the azimuth of the object
la = the observers latitude
dec = the declination of the object
h = the hour angle of the object

$h = ts - ra$

where ts = the local sidereal time (as derived in November's article)
ra = the right acsension of the object.

From these equations the altitude is directly obtained by taking the inverse sin of the right hand side of equation 3, and the azimuth is obtained by dividing equation 2 by equation 1 to get tan(az) and hence az from the inverse tan of the resulting equation.

$$\text{ie. } az = \tan^{-1}(az) = \tan^{-1}\left[\frac{\cos(dec)\sin(h)}{\cos(la)\sin(dec) + \sin(la)\cos(dec)\cos(h)}\right]$$

The following BASIC programme compututes the altitude and azimuth given the ra and dec of the object, local sidereal time and the observers latitude.

The first few lines just input the required data. the hour angle and the right hand sides of equation 1 to 3 are then evaluated. From these the altitude is calculated using the ATN (arctan) function because most basic do not directly support the arcsin ($\sin^{-1}$) function. The ATN function is not crash proof at angles of 90 degrees (corresponding to f3 = 1 in the program), the IF statements detect this condition to avoid division by zero errors.

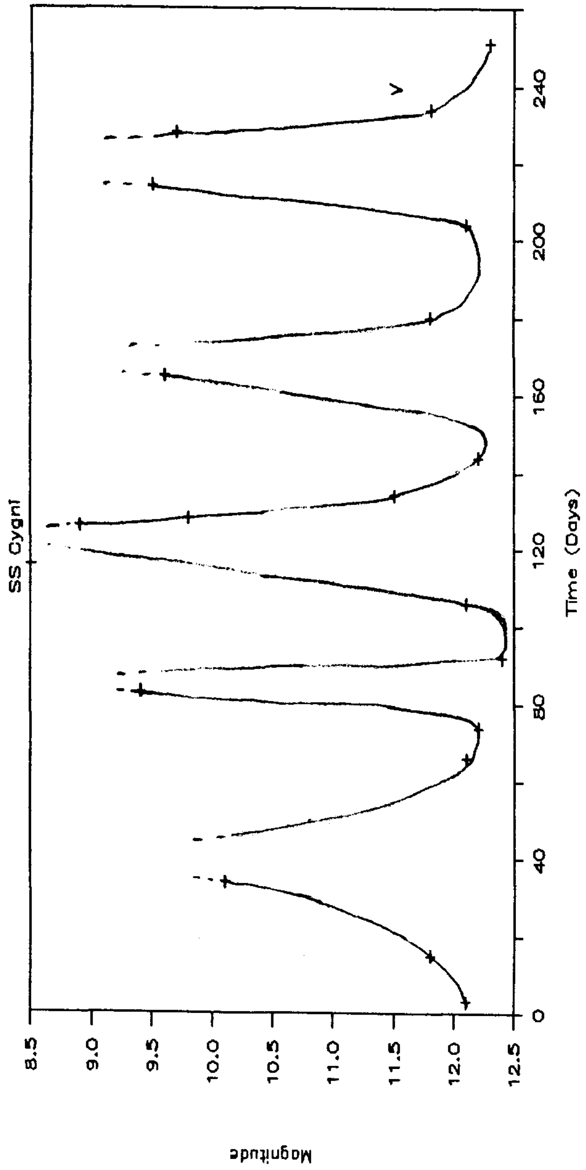
The azimuth is then calculated as described above, the first block of IF statments are there to put the azimuth in the right quadrant and the last two IFs are there to make the ATN statements crashproof.

Finaly the altitude and azimuth is printed converting radians to degrees in the process. (The lines following the input statements are converting all inputs to radians).

If the program is used as a subroutine within the sidereal time program (or vice versa) then the input line for sidereal time can be ommitted and the variable ts set within the sidereal time programme and passed to this programme at the appropriate point.

```
DEFDBL a-z
pi = 3.14159265#
INPUT "local sidereal time - hrs, min, secs ?  ", hrs, min, secs
  ts = pi*(hrs + min/60 + secs/3600)/12

INPUT "Observatory Latitude - degrees,mins,secs ?  ", lad,lam,las
 la = pi*(lad + lam/60 + las/3600)/180

INPUT "Right Ascension - hrs, min, secs ?  ", hrs, min, secs
  ra = pi*(hrs + min/60 + secs/3600)/12

INPUT "Declination - deg, min, secs ?  ", deg, min, secs
  dec = pi*(deg + min/60 + secs/3600)/180

h = ts - ra

f1 = SIN(la)*COS(dec)*COS(h) - COS(la)*SIN(dec)
f2 = COS(dec)*SIN(h)
f3 = SIN(la)*SIN(dec) + COS(la)*COS(dec)*COS(h)
 IF ABS(f3) <> 1 THEN
   altitude = ATN(f3/SQR(1-f3*f3))
  ELSEIF f3 = -1 THEN
   altitude = -pi/2
  ELSEIF f3 = 1 THEN
   altitude = pi/2
 END IF

 IF f2>=0 AND f1>0 THEN
   azimuth = ATN(f2/f1)
  ELSEIF f2>=0 AND f1<0 THEN
   azimuth = ATN(f2/f1) + pi
  ELSEIF f2<=0 AND f1<0 THEN
   azimuth = ATN(f2/f1) + pi
  ELSEIF f2<=0 AND f1>0 THEN
   azimuth = ATN(f2/f1) + 2*pi
  ELSEIF f2>0 AND f1=0 THEN
   azimuth = pi/2
  ELSEIF f2<0 AND f1=0 THEN
   azimuth = 3*pi/2
 END IF

 PRINT "altitude = ", altitude * 180/pi

 PRINT "azimuth = ", azimuth * 180/pi
```

VARIABLE STAR OBSERVATIONS



This light curve shows SS Cygni from June 1987 through to February this year. This star is one of the dwarf novae class of variables. These usually remain at a minimum for most of the time, but occasionally flare up by about four magnitudes. SS Cyg has a very rough period of 140 days, but this curve shows much more frequent outbursts.

PROGRAMME FOR APRIL

Mondays from 8pm — GENERAL OBSERVATION SECTION

11-18 Mr R Newman [redacted], Felixstowe IP11 9DY Tel. Fel. [redacted]
Mr J King [redacted], Felixstowe IP11 9LQ Tel. Fel.
-25 Mr N Taylor [redacted], Trimley IP10 0XY Tel. Fel.

Tuesdays from 8pm — GENERAL OBSERVATION SECTION

5-12- Mr R Newman [redacted], Felixstowe IP11 9DY Tel. Fel. [redacted]
-19-26 Mr J King [redacted], Felixstowe IP11 9LQ Tel. Fel.

Wednesdays from 8pm — NEBULA AND FAINT OBJECTS SECTION / CLUB NIGHT

6-13- Mr M Cook [redacted], Ipswich IP4 5PZ Tel. [redacted]
-20-27 Mr D Payne [redacted], Wickham Market IP13 0SD Tel.

Fridays from 8pm — GENERAL OBSERVATION SECTION

15- Mr P R Richards [redacted], Ipswich IP1 2HW Tel. [redacted]
Mr N Harlow, Trimley IP10 0XB Tel.
Mr R A Lobbett [redacted], Felixstowe IP11 8UJ Tel.

On nights other than Wednesday ring directors to confirm dates.

1988 COMMITTEE

CHAIRMAN	D Payne	(Address above)	Home: Work: [redacted]
VICE CHAIRMAN	D Barrard	[redacted], Ipswich IP4 5PP	Home: Work:
SECRETARY	R Gooding	[redacted], Ipswich IP1 6AE	Home:
TREASURER	M Nicholls	[redacted], Capel St Mary, Ipswich IP9 2EX	Home: Work:
MAINTENANCE	M Cook	(Address above)	Home: Work:
JOURNAL CO-ORD	E Sims	[redacted], Ipswich IP1 4NA	Home:
LIBRARIAN	P Richards	(Address above)	Home: Work:
EQUIPMENT CURATOR	R Newman	(Address above)	Home: Work:
SPECIAL EVENTS	N Taylor	(Address above)	Home: Work: