The Newsletter

of the

Orwell Astronomical Society (Ipswich)

Registered charity No 271313
www.oasi.org.uk

2009 NOVEMBER No 446

Society News (Roy Gooding)

1 2010 AGM Meeting Saturday 16th January

All members are invited to attend the 2010 AGM. The venue is at the Methodist Church Halls, in Blackhorse Lane. The meeting will start at 20:00.

2 Access into the School Grounds and Observatory Tower

Please use the third gate into the school grounds, this is the gate behind the Gym. If the Black door entrance at the base of the observatory tower is locked, you will have to phone someone in the observatory to let you in. My mobile number is . (Roy Gooding) alternatively the Observatory mobile is during meeting hours. The gate code is on the back of your membership card

3 Welcome to New Members

Norman Cooke
Michael Button
Jennifer Rowsell

4 Society Events

Meeting	Venue	Date
Geminid meteor watch	The "Dip" Felixstowe	To be confirmed
Christmas Meal	The Fountain Tuddenham	Wednesday 16th December 20:00

5 Preliminary events for 2010

At the time of writing the Autumn Astronomy in the park has not yet occurred, but going on the success of the Spring meeting, we have been asked to run the event again in the new year. This will probably become a yearly fixture.

We have also been asked to run an evening "Star Party" event in park as well. More details in the New Year.

OCCULTATIONS DURING NOVEMBER

The table lists lunar occultations which occur during the month under favourable circumstances. The data relates to Orwell Park Observatory, but will be similar at nearby locations.

Date	Time (UT)	D R	Lunar Phase	Sun Alt (d)	Star Alt (d)	Mag	Star
24 Nov	21:46:44	D	0.49+	-52	12	7.1	Hip 109637
25 Nov	23:15:42	D	0.60+	-58	10	6.2	ZC 3370
26 Nov	17:24:02	D	0.67+	-14	35	6.5	15 Psc
26 Nov	21:47:49	D	0.69+	-52	31	7.4	Hip 116865
27 Nov	20:33:54	D	0.77+	-42	45	6.8	45 Psc
28 Nov	18:58:44	D	0.85+	-28	46	6.9	ZC 177

James Appleton

Christmas Meal at The Fountain Pub Tuddenham at 20:00

Meal price £20.95
Deposit £10

Starters:

- Roast tomato basil & cream soup
- Crayfish & crab salad
- Chicken & leek terrine

Main:

- Roast Suffolk turkey
- Grilled sea base fillet
- Char grilled Scottish ribeye steak
- Roasted vegetable & chestnut crumble

Puddings:

- Christmas pudding
- Warm chocolate brownie pie
- Raspberry crème brulee
- British cheeses

URL: www.tuddenhamfountain.co.uk

Night Sky (November)

All times GMT

Moon

Full Moon	3rd Quarter	New Moon	1st Quarter
2nd	9th	16th	24th

Object	Date	Times		Mag.	Notes
		Rise	Set		
Sun	1	07:00	16:36		
	30	07:49	15:57		
Mercury	1	06:44	16:33		Mercury will be at superior conjunction on the 5th.It will be too close too the sun this month to observer.
	30	09:16	16:28		
Venus	1	05:16	16:11	-3.8	Venus remains a bright morning object. However it is now very low down in the pre-dawn sky
	30	06:51	15:31		
Mars	1	22:06	13:57	-0.1	At the start of the month Mars is in the Beehive cluster. I will only remain here for a day or so,
	30	21:05	12:31		
Jupiter	1	14:08	23:16	-2.2	Jupiter is still well place to observe this month, if you have good southern horizon.
	30	12:20	21:41		
Saturn	1	03:14	15:37	0.7	Saturn is presently a morning sky object.
	30	01:35	13:48		
Uranus	1	15:10	02:44	5.8	Uranus is still well place to on observe this month.
	30	13:16	00:48		
Neptune	1	14:16	23:53	7.9	Neptune is also well placed to observe this month. It is near to Jupiter in the sky.
	30	12:22	22:00		

Meteor Showers

Shower	Limits	Maximum	ZHR
Taurids	October 20th to November 30th	November 3rd	10
Leonids	November 15th to 20th	November 17th 12:00	20

Meteor source is the BAA Handbook

TOMLINE REFRACTOR GETS NEW DRIVE!

One of the most distinctive features of the Tomline Refractor is the large RA wheel in the cavity of the mount. The RA wheel is fixed to the polar axis of the telescope, and provides the means of turning the telescope about its polar axis to track the apparent diurnal motion of the heavens. Power to turn the telescope is provided via a worm gear which meshes with teeth in the rim of the RA wheel. (A clutch enables the worm gear to be disengaged from the RA wheel in order to slew the telescope by hand.) The worm gear lies at the end of a drive shaft protruding from the side of the mount. In the era when the telescope was commissioned, a weight-driven mechanism was used to rotate the drive shaft and worm wheel.

In 1981, members of OASI fitted a small electric RA drive to turn the drive shaft, rendering obsolete the original mechanical drive. The electric drive was housed in a small, distinctive blue box on the east side of the telescope mount. The box housed a small stepper motor, coupled to a gearbox, in turn coupled to the drive shaft. The function of the gearbox was threefold: to turn the drive train through an angle of 90° and, by virtue of a gear ratio of 72:1, to match the speed of the stepper motor to the required rotation rate of the worm wheel and to increase the effective torque. The box also housed a small pulse generator circuit, based on the ubiquitous 555 integrated circuit, and a large motor-drive board, to transform the pulses into a high-current, multi-phase drive to operate the stepper motor. A flexible cord led from the blue box to a hand controller, which housed a potentiometer and two push button switches providing control of speed of the drive. Most celestial bodies need to be tracked at siderial rate; the main exception is the Moon, which moves in RA at approximately 0.5° per hour on average.

The entire construction was a model of reuse! The stepper motor, motor-drive board and gearbox had all been recovered from other items of equipment; in fact the gearbox was an antique, coming originally from a World War I gunsight! The only newly fabricated item was the pulse generator circuit.

The electric drive provided service for many years. However, the stepper motor was small and not sufficiently powerful to drive the refractor at high speed in RA (to "catch up" an object in the sky). Additionally, in the late 1990s, the drive became unreliable. (Shortly before the drive was decommissioned, the fault was traced to a hairline crack on the motor-drive board.) Committee meeting minutes in the late 1990s and early 2000s reveal a tale of frustration and inability to rectify the problems. Dave Payne undertook a major overhaul of the drive in late 2000 – early 2001, but unfortunately this failed to resolve matters. Eventually observers learned to live with the deficiencies of the drive, and to trust to luck that problems would not manifest themselves during critical observations. However, it was apparent that the only satisfactory solution would be to replace the drive in its entirety.

In early 2009, the clutch handle broke and Martin Cook effected a repair by fabricating and fitting a new handle. While effecting the repair, he overhauled the clutch mechanism. This naturally catalysed discussion of how Martin and I could replace the electric drive, and we began to make plans....

The state of the art in electronics having advanced considerably in the almost three decades since construction of the drive, we planned completely new electronics, with all-digital control. We planned to use a larger, more powerful stepper motor that would be able to drive the telescope effectively at high speed. The flexible cord to the hand controller had long been a trip hazard in the dark of the Observatory dome, so we aimed to build a radio hand controller, obviating the need for a cord.

I concentrated on the electronics while Martin concentrated on mechanical aspects of the new drive. With the basic concept of the new drive taking shape, and some electronics already built in order to provide a proof of concept, we obtained agreement from the Committee to fund the project.

The final electronics design for the new drive comprised seven main components:

1. A large, powerful stepper motor. This was a motor which Ian Swann, a former member of OASI, had donated some years earlier. We did not posses a specification sheet for the motor, and despite Martin contacting the manufacturers in Japan, we were unable to obtain specifications. This necessitated building a degree of flexibility into the drive electronics to function over a wide range of voltages and currents so that we could maximise the torque of the motor while avoiding overheating after prolonged running.
2. A high-current motor-drive board to power the motor. It is approximately one sixth the size of the drive board in use formerly!
3. An adjustable voltage, high-current power supply for the stepper motor. This is a 70w switch-mode unit capable of delivering a voltage in the range 5-24v. Early experiments determined that the optimum drive voltage for the stepper motor was 6v, at which torque was maximum without risk of overheating.
4. A four-channel FM handheld transmitter. This unit is licence-exempt, operating in the 433 MHz band, and uses KeeLoq encryption. The four channels provide the following functions: *increase speed, decrease speed, stop* and *fast.*
5. An FM receiver-decoder module, matched to the transmitter.
6. A backup, corded four-channel hand controller which can be plugged in should the radio hand controller fail.
7. A timing and control board, also known as the "PIC board". The function of this board is to generate timing pulses and feed them to the motor-drive board to cause the stepper motor to rotate. It must generate pulses at the correct nominal frequency (corresponding to sidereal rate) and enable the frequency to be increased and decreased under control of the FM transmitter/receiver.

I purchased items 2-5 from various commercial suppliers and constructed items 6 and 7. Construction of the PIC board created the most work. Although the 555 integrated circuit used in the previous drive can form a stable and reliable pulse generator, it does not easily lend itself to digital control over the pulse frequency, and I therefore instead chose a PIC 12F629 microcontroller "chip" to generate timing pulses. The 12F629 offers great flexibility with multiple input/output ports, timers, comparators and other features that make it ideal for timing and control applications. It is fully programmable: the user creates a software programme on a PC, and then downloads it to the chip to control operation of the latter.

My first task, therefore, was to learn how to programme the 12F629! For this I purchased a general purpose PIC development board and PC software environment. The general purpose nature of the development board meant that it was populated with components (LEDs, resistors, a potentiometer, etc) which could be used to learn how to programme the chip to interact with its electrical environment. I wired a circuit around the development board simulating part of the environment of the PIC board within which the 12F629 would ultimately reside: an LED provided a visual indication of the pulse frequency and pushbuttons signalled to increase or decrease the frequency.

Initial progress programming the 12F629 was rapid: after only a few days I had programmed the chip to flash the LED at precisely nominal frequency. Encouraged by my initial success, I then tried to implement digital control over the frequency, arranging for the 12F629 to read the state of the pushbuttons and when one or other was pressed, to increase or decrease the frequency accordingly… and this is where I encountered serious difficulties! Programming the chip with the required functionality was comparatively straightforward, but it proved impossible to obtain consistent, stable results; always the frequency of output pulses either eventually decreased to zero or eventually increased far beyond the desired rate. After several weeks of puzzling over this situation, becoming increasingly frustrated, the cause eventually suggested itself in a flash of inspiration! Leakage currents through the various components installed on the development board were cross coupling the output of the chip back to the input, and the chip was interpreting the bogus inputs as instructions to increase or decrease the output frequency. Of course, with hindsight, the cause of the problem was entirely obvious! I therefore constructed a prototype of the PIC board to hold the chip, connected to the development board in a minimal fashion so as to avoid the effect of all extraneous components, and thereafter development progressed smoothly once more.

By late May the prototype PIC board was fully working and I had debugged and calibrated the software for the chip. I then assembled a full mock-up of the electronics, to check that everything functioned properly: fortunately it did! Unfortunately, extended testing revealed the radio hand controller to be not totally reliable: the PIC board would occasionally fail to respond to a command from it. However, I was not unduly perturbed by this, as I have learned from experience with other radio-based products (two wireless weather stations and wireless broadband) that my home lies in a radio-frequency "hot spot", where ambient levels can disrupt low-power radio communication.

On 03 June, I took the electronics to the Dome at Orwell Park, and Martin and I checked that it functioned properly, this time, *in situ*. Performance was perfect. Earlier worries that we had shared about potential problems of radio reception in the vicinity of the large mass of metal in the Dome proved groundless. Operation of the radio hand controller proved reliable even from the foot of the Observatory Tower! Encouraged by this, over the summer I constructed the final version of the PIC board and the other electronics for the new drive.

Meanwhile over the summer, Martin purchased a very smart beige metal case to house the new drive. The new case was considerably larger than the old one, enabling easier maintenance *in situ*. The larger physical dimensions meant that Martin could attach it directly to the foot of the mount of the Tomline Refractor, rather than via a bracket as had been the case with the previous drive.

We spent much time discussing how best to mount the motor and gearbox in the new case. Our ideal solution would have been to purchase a new planetary gearbox which would enable us to mount both motor and gearbox coaxial to the drive shaft and avoid the need to turn the drive train through 90°. Unfortunately, we could not locate a sufficiently robust planetary gearbox, so after much discussion, we decided to retain the old gearbox, mounting the motor at 90° to the drive shaft. Martin fabricated an ingenious hinged mounting for both stepper motor and gearbox, which held the two in the same position relative to one another but enabled the pair to move together to accommodate the change of position of the drive shaft when the clutch was operated to move the worm wheel in and out of mesh with the RA drive wheel.

Martin fitted out the case internally to accommodate the various electrical and mechanical components of the new drive and on Saturday 05 September, delivered it to me for final fit-out. I installed the electronics that day and set aside the following afternoon to test the complete assembly. The next day being sunny, I conducted the tests outside, with the usual Sunday-afternoon background noise: traffic, neighbours, dogs, the wind, etc. After finishing testing I returned the complete assemblage to Martin. We decided on a last trial of the drive in Martin's workshop as a final check before installation. Mechanically and electrically everything worked as it should, but... vibration from the stepper motor unfortunately travelled through the hinged mounting and triggered a resonance in the sides of the case: in the quiet of Martin's workshop, the resonance was rather loud. It was immediately obvious that in the quiet of the observatory dome in the middle of the night, observers would not thank us for introducing noise pollution! We experimented with temporary bracing to the sides of the case, but nothing we tried made a significant difference to noise levels.

Eventually Martin devised a solution to the noise problem. By placing rubber gaskets between facing surfaces associated with the stepper motor and its hinged mount he was able significantly to decouple the motor from the case and reduce the resonance to an acceptable level. A permanent solution will be effected shortly by fitting commercial vibration dampers.

On Wednesday 09 September, Martin installed the drive at Orwell Park. We completed an informal star-tracking test at 21:00 BST and thereafter declared the drive ready for use! (In fact, the star-tracking test suggested that the nominal drive rate is slightly slower than sidereal, but the result is not conclusive, and the test needs to be repeated with greater care.)

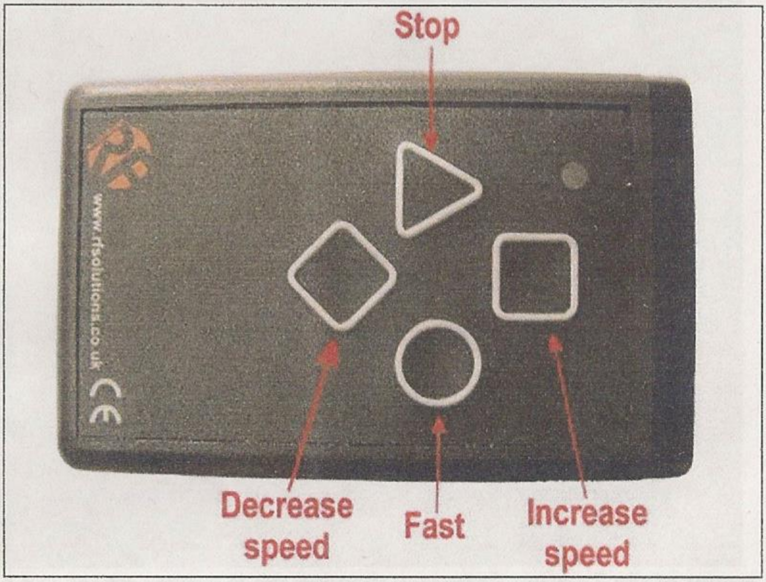
One of the advantages of using a programmable chip to control the drive is that it can be upgraded with new functionality as required. The benefit of this became apparent as soon as the drive was installed. When first powered up, the drive operates at nominal (sidereal) rate. It was clear that a means of resetting the drive to nominal rate while in use, without switching it off and on again, would be very beneficial. I programmed another 12F629 chip to reset to nominal rate when the *increase speed* and *decrease speed* controls are pushed simultaneously, and on Wednesday 16 September replaced the 12F629 in the drive with the upgraded chip.

I'd be very happy for users of the drive to provide any feedback and suggestions for further upgrades and improvements.

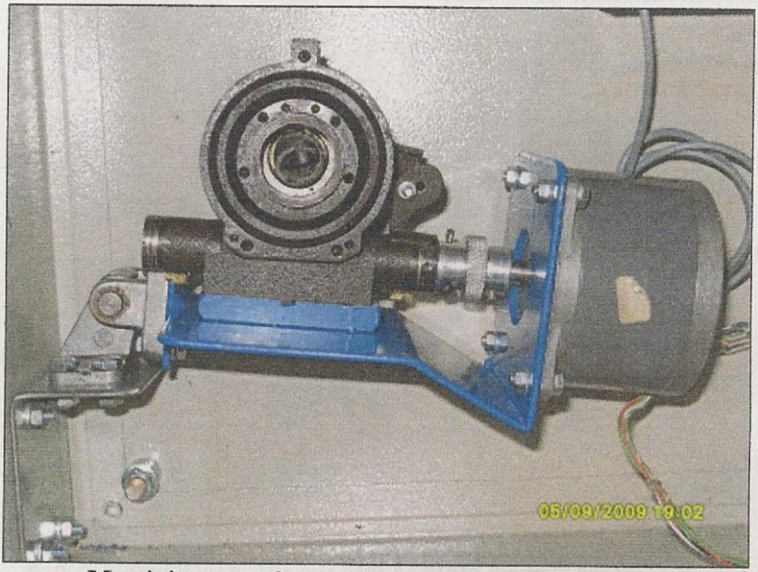
James Appleton, 09 October 2009

The mount of the Tomline Refractor showing the RA drive wheel and blue box containing the former electric drive.

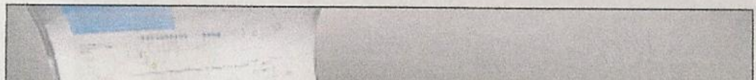
The completed drive being tested outdoors on a (noisy) Sunday afternoon.



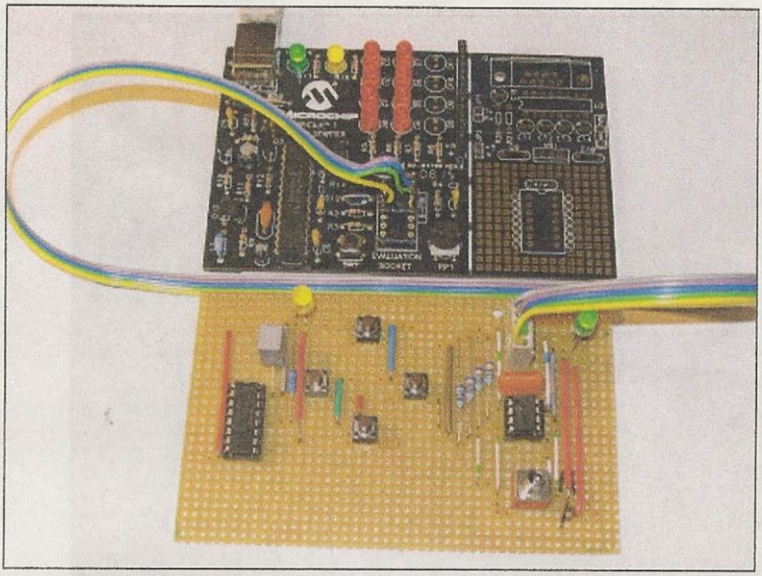
The new wireless hand controller.



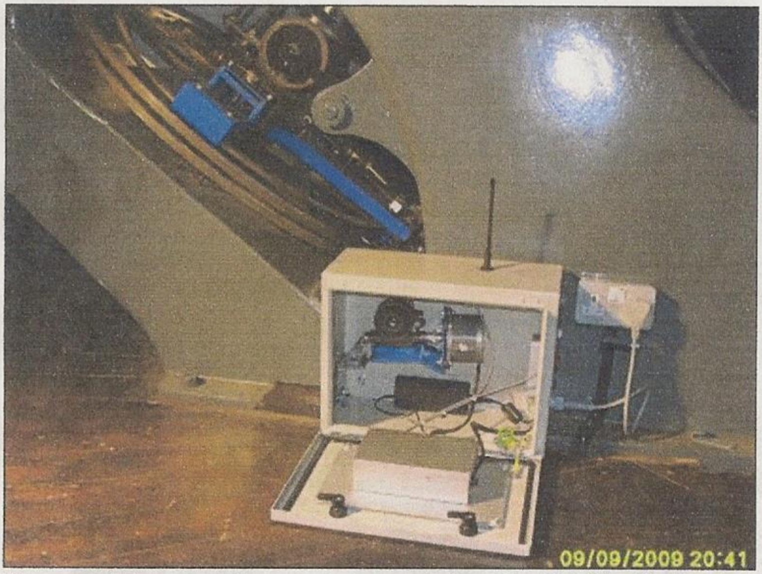
Martin's mount for the stepper motor and gearbox.



The new drive electronics being tested at Orwell Park on 03 June 2009.



The prototype PIC board (lower) plugged into the PIC development board (upper).



The new drive, case door open, mounted on the Tomline Refractor.

Having imaged the two brightest Kuiper Belt Objects (KBOs), excluding Pluto, in May I attempted a much fainter object last night. The list of the 20 brightest KBOs is given in the BAA Handbook for 2009 and the best placed object at the moment in 2002TX300 in Andromeda. There are other slightly brighter objects but they are much too low in the sky for me to image.

The image attached may not look much but it does show 2002TX300 at magnitude 19.6...the faintest object I've imaged so far. Note that the star images are round whereas the KBO is slightly elongated as it moved just over 3 arc seconds during the hour or so it took to accumulate the images.

2002TX300 is estimated to be just 600km in diameter, very slightly larger than Saturn's moon Enceladus but much darker, and is currently 40.6 AU from the Earth. It orbits the Sun once every 286 years.

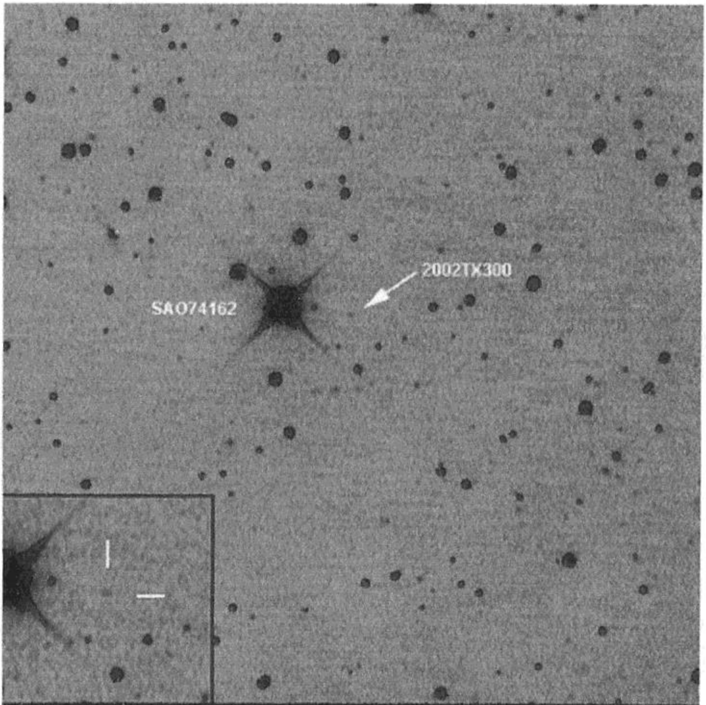
This is pushing the limits of what I can image with my telescope...going fainter will require significant improvements to the tracking accuracy so I can add together many images of several minutes each.

Incidentally, if we could take images with the MMT we could reach at least magnitude 21...!!!

Mike.

(2002TX300 also has asteroid number 55636. It was discovered on 15th October 2002)

The image from Mike Harlow is on the next page.



KBO 2002TX300. 2009 September 26th 22:35 to 23.44UT
30cm F/4.3 Prime focus reflector + MX916CCD
54 x 30 seconds, FOV 15' x 15' N up. Mike Harlow
Inset shows enlarged view

OASI Committee Contacts & Responsibities

Neil Morley	**Chairman**	☎ [redacted]	
Roy Gooding	**Secretary**	☎ [redacted]	**MAIN POINT OF SOCIETY CONTACT** Press Publicity with Chairman. Observatory Decoration. Visits by potential new members.
Paul Whiting FRAS	**Treasurer**	☎ [redacted]	**Finance.** Supervision of Grant Applications. Visits by outside groups. **IYA 2009 Coordinator**
James Appleton	Committee	☎ [redacted]	Committee Meeting Minutes. Web Site.
Martin Cook	Committee	☎ [redacted]	Membership. Tomline Refractor Maintenance.
Peter Richards	Committee	☎ [redacted]	Lecture Meetings. Email Distribution Lists.
Eric Sims	Committee	☎ [redacted]	Newsletter.
Mike Whybray	Committee	☎ [redacted]	Librarian & Workshops.
Bill Barton FRAS	Committee	☎ [redacted]	Safety & Security.
John Wainwright	Committee	☎ [redacted]	Forward planning & Strategy Equipment Curator

DIARY For NOVEMBER

Monday 5th & 19th From 8pm	**SMALL TELESCOPES OBSERVING NIGHTS AT THE OBSERVATORY** Main observational targets: Cassiopeia Cygnus Moon & Jupiter ☎ Paddy O'Sullivan [redacted] ☎ Gerry Pilling [redacted]
Wednesdays **From 8PM**	**MAIN OBSERVATORY CLUB NIGHTS** Primary Observational targets: Nebulae and faint objects. ☎ Martin Cook [redacted] (mobile) [redacted] ☎ Roy Gooding [redacted] (mobile) [redacted]
Wednesday 7th Open 7.30 Start 7.45	**OASI WORKSHOP** Millennium Telescope observing night Nacton village Hall ☎ Mike Whybray [redacted]
Thursday **3rd 8pm** **5th 8pm** **12th 8pm** **19th 7.30pm** **26th 7.30pm** **5th 8pm**	**OBSERVATORY VISITS BY LOCAL COMMUNITY GROUP** Private group Westbourne College 27th Ipswich Guide Group 31st / 9th Britannia Cubs 2nd Ipswich Cubs **Taster evening** ☎ Paul Whiting FRAS [redacted]
Saturday 16th January @ 8pm	**ANNUAL GENERAL MEETING** **Methodist Church Hall** **Blackhorse Lane Ipswich**

Astronomy in the park at Christchurch Park in Ipswich
Saturday 31st October & Sunday 1st November 11-00 15-00
At the Reg Driver Visitors Centre by the Bolton Lane entrance.

Society Primary Contacts

Chairman: Neil Morley ☎ [redacted]
Secretary: Roy Gooding ☎ [redacted] (daytime) [redacted] (evenings)
E-Mail queries: Ipswich@ast.cam.ac.uk

Society Trustees

Society Honorary President

Professor Allan Chapman D.Phil MA FRAS

Observatory Telephone Number

Meeting nights only [redacted]