The Newsletter of the Orwell Astronomical Society (Ipswich)

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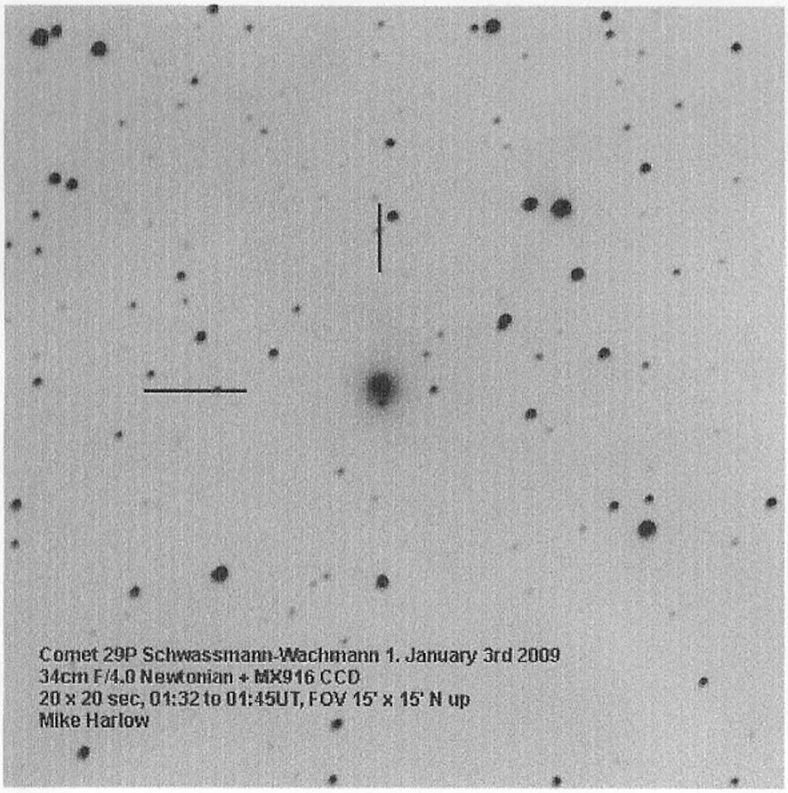
2009 March No 439



Comet 29P Schwassmann-Wachmann 1. January 3rd 2009
34cm F/4.0 Newtonian + MX916 CCD
20 x 20 sec, 01:32 to 01:45UT, FOV 15' x 15' N up
Mike Harlow

Society News (Roy Gooding)

1 Committee Meeting Sunday 19th April 2009 at 7:30pm

All members are invited to attend the next Committee meeting, on Sunday 1st February at 15:00 at Nacton Village Hall **Please note date, time and venue**

2 Observatory Keys

A new set of observatory key costs the society £18. If you have a set of keys that you no longer need please return them to Roy Gooding

3 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 [redacted]. (Roy Gooding) alternatively the Observatory mobile is [redacted] during meeting hours. The gate code is on the back of your membership card

4 Welcome to New Members

Chris Bailey
Jon Styles
Lee Ransome

5 Lecture Meeting Venue

Our town lecture venue is now at the Methodist Church Halls, in Blackhorse Lane. The Church has a car park, which can take about 30 cars.
Black Horse Lane has only one entrance, which is from Elm Street. This is just past the Police Station, if you are arriving from Civic Drive. The church car park is on the right, just past the Black Horse pub.

Meetings start at 20:00 doors open at 19:30

Spring Open Weekend

The Open Weekend this year will be held on Saturday 4th and Sunday 5th April. Doors open for the public at 19:30

As usual as much help, as possible is required to make the Spring Open Weekend a success.

If you are only available to help for a short time your presence will still be appreciated.

A poster is included with this Newsletter, please find a suitable place to display it.

6 Events for International Year of Astronomy 2009 (IYA 2009)

Spring Meetings	Venue	Date
Astronomy Evening Option 1	Orwell Country Park	Saturday 21st March 19:30 to 23:00
Astronomy Evening Option 2 If it is cloudy on the 21st March	Orwell Country Park	Saturday 28th March 19:30 to 23:00
Talk and Telescope Evening	Nacton Village hall	Monday 30th March 19:30
Talk and Telescope Evening	Nacton Village hall	Tuesday 31st March 19:30
Sidewalk Astronomy (Night Observing)	The Ship Levington	Thursday 2nd April 19:30
Spring Open Weekend	Orwell Park Observatory	Saturday & Sunday 4th & 5th April 19:30 to 22:00
Astronomy in the Park Solar observing	The Visitors Centre Christchurch Park (Bolton Lane entrance)	Saturday & Sunday 30th & 31st May 11:00 to 16:00
Autumn Meetings	**Venue**	**Date**
Autumn Open Weekend	Orwell Park Observatory	Saturday & Sunday 24th & 25th October 19:30 to 22:00
Talk and Telescope Evening	Nacton Village hall	Monday 26th October 19:30
Talk and Telescope Evening	Nacton Village hall	Tuesday 27th October 19:30
Sidewalk Astronomy (Night Observing)	The Ship Levington	Thursday 29th October 19:30
Astronomy in the Park Solar observing	The Visitors Centre Christchurch Park (Bolton Lane entrance)	Saturday & Sunday 31st October & 1st November 11:00 to 15:00

The success of our contribution to IYA 2009 is dependent on the enthusiasm of our members. Please come along to as many events as you can.

Telescopes are needed for events at Orwell Country Park, The Ship, and Astronomy in the Park (preferably solar ones if available)

For more information please contact Paul Whiting or Roy Gooding

7 Other Society Events

Meeting	Venue	Date
SPA Convention 2009	Institute of Astronomy Madlingley Rd Cambridge	Saturday 7th March 10:00 to 17:30
Astronomy Workshop Laurence Newell talking on *Radio Astronomy*	Nacton Village hall	11 March 2009 19:45
Astronomy Workshop Second Beginners' Workshop	Nacton Village hall	08 April 2009 19:45
Summer Barbecue	Newbourne Village Hall	June TBA
Perseid meteor	The Dip" Felixstowe"	Saturday 15th August 20:30
Geminid Meteor watch	The "Dip" Felixstowe	TBA
Christmas Meal	TBA	Wednesday 16th December

Night Sky (March)

All times GMT

Moon

1st Quarter	Full Moon	3rd Quarter	New Moon
4th	11th	18th	26th

Object	Date	Times		Mag.	Notes
		Rise	Set		
Sun	1	06:53	17:43		
	31	05:42	18:37		
Mercury	1	06:21	15:24	-0.2	Mercury is in the early morning twilight sky
	31	05:50	18:36		
Venus	1	07:13	21:18	-4.1	Venus remains a prominent evening object for about the first half of the month, bcefore it passes inferior conjunction on the 27th .
	31	04:45	18:23		
Mars	1	06:21	15:32	1.2	Mars stays in the morning twilight this month.
	31	05:05	15:50		
Jupiter	1	06:04	15:00	-2.0	Jupiter is an early morning object, this month.
	31	04:17	13:35		
Saturn	1	18:16	07:32	0.5	Saturn remains well placed for observing all night. It will be at opposition on the 8th
	31	16:00	05:26		
Uranus	1	07:19	18:45	5.7	Uranus is at conjunction on the 13th
	31	05:20	16:53		
Neptune	1	06:28	16:09	7.8	Neptune remains in the morning twilight this month.
	31	04:29	14:13		

Grazing Lunar Occultation of Alcyone

By James Appleton

A grazing lunar occultation of the mag 2.8 star Alcyone was predicted to occur at 17:55 UT on 07 January 2009. The star is a member of the naked-eye grouping *The Pleiades*, and accordingly the graze would be accompanied by several total occultations in the minutes before and after. For once, the event would occur at a sociable time, and would not require observers to get up in the middle of the night!

Excited by the prospect, the usual OASI graze observers (James Appleton, Martin Cook, Roy Gooding and Alan Smith) began making plans. All except Roy decided to attempt an observation (work commitments unfortunately prevented Roy from participating) and Dave Payne also indicated that he would join the party. The observers made the usual preparations: James provided detailed predictions of the graze track and Alan reconnoitred potential observing locations. By a stroke of good luck, Alan found that he had a friend who lived only some 200m N of the graze line, close to Shrubland Hall, just off the A140. Alan negotiated with his friend, who agreed to let the observers occupy his back garden, thereby providing the ideal observing site.

Unfortunately, on 07 January, dense cloud blanketed the whole of East Anglia from early morning onwards. A brief thinning of the cloud over Ipswich around midday raised hopes, but these were short-lived as the cloud cover rapidly re-established itself. The prospective observers called off their intended observations at approximately 1.00pm.

OCCULTATIONS DURING MARCH

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
02 Mar	19:27:55	D	0.33+	-18	45	6.8	ZC 470
02 Mar	20:53:11	D	0.33+	-30	33	7.3	Hip 15267
03 Mar	22:53:59 23:46:22	D R	0.45+	-42 -44	25 18	5.4	chi Tau
06 Mar	23:21:20	D	0.78+	-42	46	6.5	ZC 1144
07 Mar	01:26:26	D	0.79+	-40	28	7.0	ZC 1152
08 Mar	00:09:51	D	0.88+	-43	44	7.4	Hip 42058
10 Mar	18:53:05	D	1.00+	-10	11	5.5	65 Leo

A note about parking for workshop events:

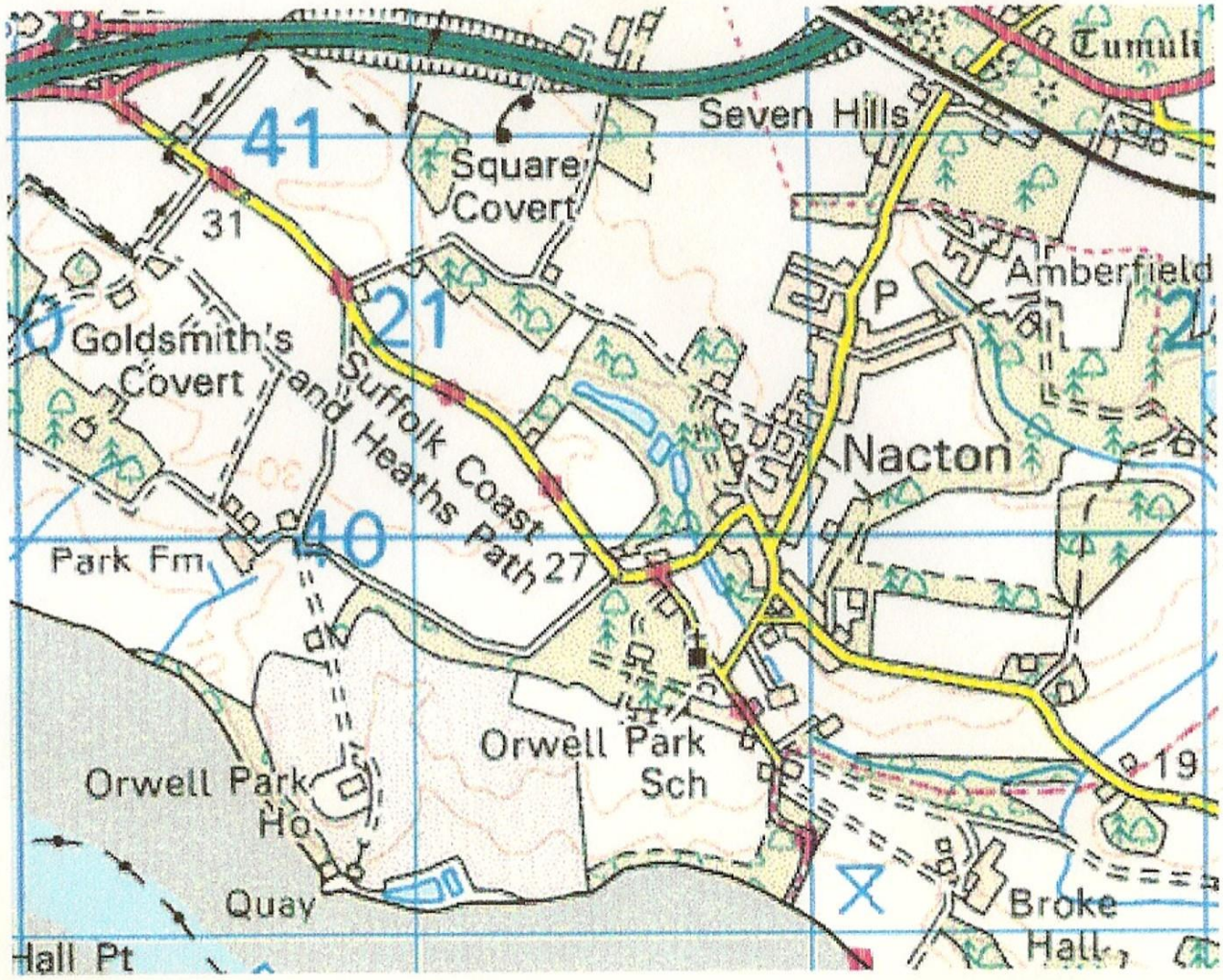
The Workshops are at Nacton Village Hall, next door to Nacton CEVC Primary School.

There is plenty of parking along the road ("The Street") near the hall.

Please park on the same side of the road as the Hall.

Do not park on the opposite side of the road to avoid the risk of causing an obstruction. Note that occasionally large vehicles run at night to and from Home Farm just down the road. Note also that there are kerb-side white lines on the road indicating places where parking is not advised. Drivers can stop to drop off passengers right outside the hall (where there is a kerb-side white line) and then park further down the road.

Map of Nacton. Venue: NACTON VILLAGE HALL IP10 0EU (next to the small village school, just below and left of the N in Nacton on the map)



More Astronomy Workshops

Doors open at 7:30pm.
Workshops START at 7:45pm

Venue: NACTON VILLAGE HALL IP10 0EU (next to the small village school, just below and left of the N in Nacton on the map)

Date	Event	Run by…
11th March 2009	**Introduction to Radio Astronomy** An introduction to radio astronomy with emphasis on what can be achieved by the amateur. Demonstration of hardware and software being developed by the BAA's Radio Astronomy Group for a networked radio observatory.	**Dr Laurence Newell, Co-ordinator BAA Radio Astronomy Group**
8th April 2009	**Beginners Night – Part 2** After Part 1 in February which covered an overview of our universe, what you can observe yourself, and the main types of telescope you could consider buying, Paul will go more deeply into the solar system and different types of stars and their fates. Hopefully we'll have one or more telescopes present again for you to poke and prod.	**Paul Whiting**

Mike Whybray
Workshops organiser
(Mobile)
(Home)

Telescope Loan Scheme

Given that it is International Year of Astronomy (IYA2009), this month, we're starting a scheme to offer OASI members a selection of telescopes for short-term loan (up to a month). Maybe a member is considering purchasing a telescope and isn't sure whether it's the right choice for their needs. Maybe it is needed to support an observing project.

Here are the telescopes presently include in the loan scheme, the list will be reviewed and updated over a period of time:

1. Fullerscopes 6" Reflector

Presently located in the Belvedere area, this is a fairly substantial reflector with good optics suitable for viewing the moon, planets and brighter deep sky objects. It is equatorially mounted but its mount is fairly basic in design. It allows both declination and right ascension axes to be locked in a fixed position or slightly loosened to allow movement by hand. However the mount does not have slow motion drives. An improvement would be to re-mount the scope. Both primary and secondary mirrors have been recently re-coated.

2. Tasco 4.5" Reflector

Presently located in the storage area at the foot of the observatory, the main benefit is it is a short tube design and therefore portable and lightweight. However it is let down by its optics. The use of a spherical primary mirror means the light rays do not achieve a single point of focus. Its secondary

is undersized so not all of the light from the primary mirror reaches the eyepiece. This reduces image brightness to a 60mm refractor. This scope is boxed and supplied with eyepieces but they are the Japanese 0.965" diameter so largely incompatible with other scopes.

3. Prinz 660 76mm refractor

Presently located in the Belvedere area, the scope has been refurbished and includes a 1.25" eyepiece adapter allowing standard eyepieces to be used (originally supplied with 0.965" eyepieces). Reasonable quality images; good for observing the moon and brighter planets.

Terms of Use

The loan covers the telescope only, and does not include eyepieces (unless otherwise stated). The member is expected to supply their own eyepieces and take reasonable care of the telescope whilst it is in their possession. If you are interested in taking this further:

1. Please get in touch with John Wainwright (Equipment Curator)
2. Fill in the loan book located in the right hand side cupboard of the library bookcase (Belvedere area).
3. Consider a "handover" session with John or myself before loaning the scope!

Neil Morley

CALL FOR VOLUNTEERS

YOUR SOCIETY NEEDS YOU

We are looking for a large number of volunteers to help with the many IYA events we have planned this year (see event listing).

The Tea, Talk & Telescope evenings need people to help with the telescopes, crowd control and catering.

The Sidewalk Astronomy sessions (Orwell Country Park, Christchurch Park and The Ship at Levington) require people to help with the telescopes and talk to the public.

Finally the Observatory Open Days require the normal large number of volunteers to help with parking, crowd control, money collecting etc. etc.

Please consider volunteering, and contact me or any member of the committee, with your availability and job preference.

Paul Whiting

Chairman's Chat

At the time of writing, we are well into the winter with a significant cold spell upon us. According to the News, the country has experienced the most significant snowfall in around 20 years! Planning for an extended observing session this time of year takes a fair amount of preparation and persistence. However the good news is we have a comet in our skies named C/2007N3 Lulin.

Mike Harlow sent an email to the OASI mailing list after observing the comet at 4:30am on Feb 4th. The comet was easy to find in 10x50 binoculars just east of the bright, wide double stars of alpha Librae. It had a typical circular coma but no evidence of any of the tails seen in some images. Comparing it to Messier object M13 in Hercules, the comet appeared slightly larger and fainter although its much lower altitude of 19 degrees above the horizon may have affected this. It was too low in the sky for Mike to image from his garden. Mike estimated the brightness at Magnitude 6 and has suggested the following website for a selection of images and findercharts for those interested in viewing the comet: http://www.spaceweather.com/comets/gallery_lulin.htm.
If anyone has suitable imaging equipment and/or would like to write an article based on their observations and experiences, please pass on your results to the Newsletter. I know Eric Simms is always pleased to receive new material. If you manage to image the comet, I am sure James Appleton would be happy to include pictures on the OASI web site.

On Feb 1st, the first Committee meeting took place with yours truly in the hot seat. We have a packed year with IYA2009 upon us and now need you to come forward and volunteer! Please get in touch with the committee members mentioned below if you can help with any of these events. International Year of Astronomy (IYA) events are labelled IYA2009.

- Astronomy Evening on 21 or 28 March 2009 (IYA2009). Please note that there was a misprint in last month's Newsletter where there were two "options" listed on the same date of 21st March! The intention is weather permitting this event takes place on 21st March, in which case the following weekend, the 28th will be cancelled. If the weather on the 21st precludes observing, then the event will be moved to the 28th. Ipswich Country Rangers are organising the event and OASI supporting it for IYA2009. The location is Bridge Wood / Foreshore and not Pipers Vale. *Bridge Wood* car park is off the Nacton Road, along the former airfield perimeter track and over the A14 bridge before turning sharp right down to the wood. Please refer to the map at the end of this article. OASI volunteers will be needed to bring along and demonstrate portable telescopes and binoculars/tripods as well as promote the benefits of joining OASI. Please bear in mind there is half a mile walk from the park entrance to the foreshore, therefore reasonable fitness, stout outdoor footwear and outdoor clothing is required. A torch is useful for the return trip. The start time for this event is 7:30pm

and it finishes at 11:00pm. Please contact Paul Whiting if you are able to help in any way.

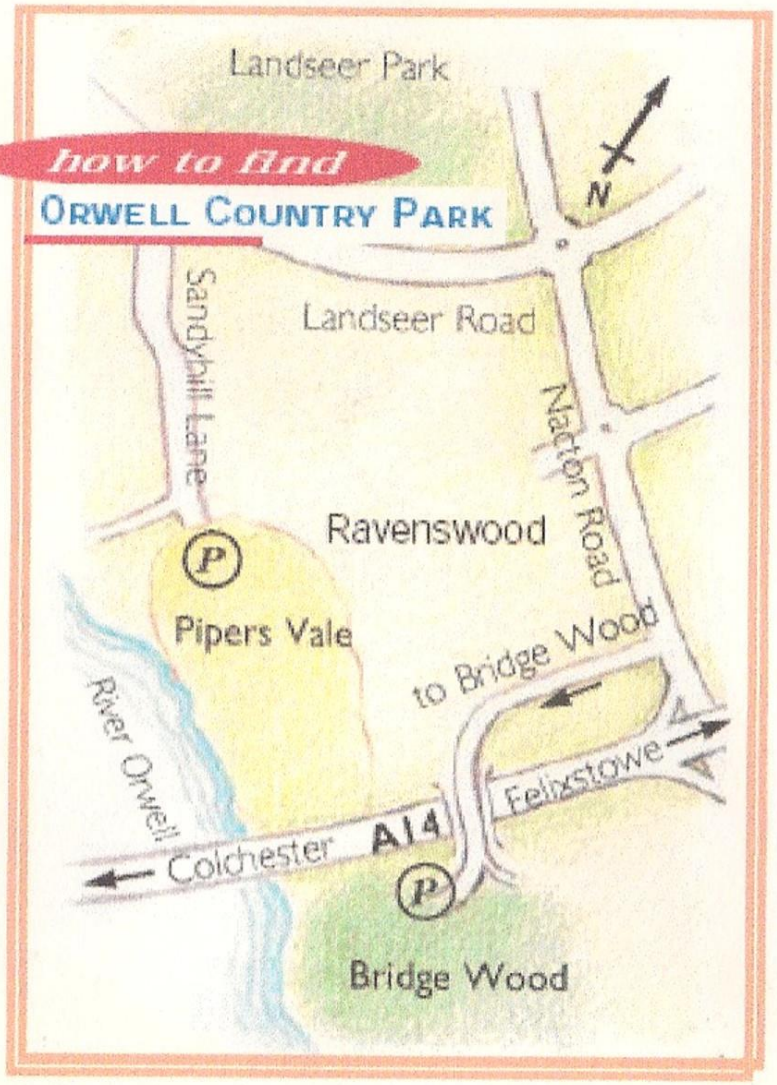
- Talk & Telescopes evenings at Nacton Village Hall, 30-31 March 2009 (IYA2009). The Millennium Telescope (MMT) and other instruments will be brought to the event. Members of OASI will be needed to help transport and operate the MMT, demonstrate the use of telescopes, meet and greet people, and to emphasise the benefits of joining OASI. The event is scheduled to start at 7:30pm. Please contact Paul Whiting or Mike Whybray if you are able to help with any of these tasks.
- Sidewalk Astronomy at *The Ship*, Levington 02 April 2009 (IYA2009). The Millennium Telescope will be used at this event. Volunteers will be needed to help transport and operate the MMT and meet and greet people. The event starts at 7:30pm. Please contact Paul Whiting if you are able to help with any of these tasks.
- Open Weekend 04-05 April 2009. Volunteers will be needed to help with general spring-cleaning to prepare the observatory ahead of the event, provisionally the two Wednesday evenings preceding it on 18th and 25th March. Volunteers will also be needed during the open weekend to help with car parking, to help meet and greet visitors on the door, collect payments, show them around the observatory, as well as demonstrating various telescopes and explaining the benefits of membership. The Open Weekend runs from 7:30pm to 10pm each day. Please contact Roy Gooding if you are able to help in any way.

- Astronomy in the Park 30-31 May 2009 (IYA2009). The theme is Solar Observing. Roy is in the stages of confirming with Ipswich Borough Council that members of OASI bringing equipment to the event will be able to park in the Christchurch Park car park to ease access. At this stage, Gerry Pilling will bring the OASI Meade ETX125 with solar filter as well as the OASI solar telescope. Bill Barton and Paul Whiting will also be bringing their own solar telescopes. Volunteers will be needed to help meet & greet and to emphasise the benefits of joining OASI. The event runs from 11am to 4pm both days. Please contact Roy Gooding or Paul Whiting if you are able to help.
- Perseid meteor count at "The Dip" Felixstowe. The Meteor maximum takes place on 12-13 August 2009. Presently, arrangements are being finalised. If you are interested in attending, please contact Roy Gooding.

If you have any further questions, please get in touch with any committee member! Earlier in February, I received a further update from our former chairman Ken Goward. Some of you will know that Ken has had an awful spate of bad luck and was recently hospitalised again with a serious heart condition. Ken recently wrote an email to the Committee explaining he had just come out of hospital where he'd literally been at the brink, it was that serious. He has pulled through magnificently and now has a pacemaker. Ken on behalf of OASI, this is EXCELLENT news, we are relieved to hear you are much

better now and wish you all the very best for your continuing recovery!

Finally, here's a location map accompanying the Astronomy Evening on the 21st or 28th March.



Neil Morley

Summary Of OASI Committee Meeting 01 Feb 2009

Main points of the Committee meeting of 01 February 2009 are detailed below. Please consult any member of the Committee if you wish any more information.

1. At the AGM in January, Neil Morley had been elected Chairman. The Committee agreed that other roles and responsibilities would remain largely as in 2008, with the two changes detailed below. (See inside back page of this Newsletter for the full list of Committee members and responsibilities.)
   - John Wainwright takes over the role of equipment curator in addition to his responsibility to explore future strategies for OASI.
   - Pete Richards gives up the role of liaison with Orwell Park School over lighting issues. The Committee will fulfil this role jointly.
2. OASI funds are at acceptable levels.
3. Parking problems at recent OASI lecture meetings at the Methodist Church Hall may be resolved: members of OASI are permitted to park at the rear of the solicitors' offices adjacent to the Hall, effectively doubling the amount of parking space available.
4. Paul Whiting has organised numerous OASI events to mark IYA2009 – see the Newsletter or OASI web site for details.
5. A member of OASI had written to Neil Morley suggesting that a handrail be fitted to the spiral staircase in the Observatory and offering to donate a considerable sum towards the cost. However, the terms of OASI's licence with Orwell Park School mean that it is the responsibility of the School to install any such new fittings to the fabric of the building. The Committee will raise the matter with the School, with a view to having a handrail installed as part of the wider renovation of Orwell Park Observatory being planned by the School.

6. The Committee will organise cleaning and tidying of the Observatory prior to the Open Weekend 04-05 April 2009.

7. The Committee will arrange for the floor of the Dome to be re-varnished during summer 2009.

8. Dave Balcombe, Secretary of Norwich Astronomical Society, had approached Roy Gooding with a view to forming an East Anglian Group of Astronomical Societies. This idea had last been tried some 20 years ago and had soon folded. The Committee agreed to reply in a non-committal way with a general expression of interest, and to monitor how the proposal develops.

9. Congratulations from the Committee to Dave Robinson who has passed the Tomline Refractor operating test.

10. Paul Whiting and Roy Gooding were modelling in a most fetching manner clothing branded with OASI and IYA logos, available to all members of OASI. (Details of web site for ordering garments are elsewhere in this Newsletter.)

11. Neil Morley will ask Dr Allan Chapman for suggestions about obtaining funding for historic buildings such as the Observatory.

12. Paul Whiting has arranged for the OASI computer to be connected to the Orwell Park School network.

13. Date of next Committee meeting: Sunday 19 April 2009 at 7:30pm in Nacton Village Hall. All members of OASI are welcome to attend.

James Appleton
10 February 2009

Finder chart for comet Lulin (C/2007 N3)
- From January 11th to February 20th, 2009
Prepared by Gregorio Drayer
Caracas, Venezuela
http://www.astrodrayer.com
N
S
W
Serpens
Virgo
Hydra
Crater
11-Jan-2009 Mag:8.3
13-Jan-2009 Mag:8.2
15-Jan-2009 Mag:8.2
17-Jan-2009 Mag:8.1
19-Jan-2009 Mag:8.0
21-Jan-2009 Mag:7.9
23-Jan-2009 Mag:7.8
25-Jan-2009 Mag:7.7
27-Jan-2009 Mag:7.6
29-Jan-2009 Mag:7.5
31-Jan-2009 Mag:7.4
2-Feb-2009 Mag:7.3
4-Feb-2009 Mag:7.2
6-Feb-2009 Mag:7.0
8-Feb-2009 Mag:6.9
10-Feb-2009 Mag:6.8
12-Feb-2009 Mag:6.6
14-Feb-2009 Mag:6.5
16-Feb-2009 Mag:6.3
18-Feb-2009 Mag:6.2
20-Feb-2009 Mag:6.1
C/2007 N3 Lulin
Mag:6.1

UK Launch Event for IYA 2009

On Wednesday 18th February I was invited to attend the official UK launch press event for International Year of Astronomy (IYA) held at the Royal Greenwich Observatory.

The tone of the evening was set with a free shuttle minibus up the hill, with uniformed security guards checking invitations at the Royal Park gate (the park had closed at 6pm).

On arrival at the Observatory we were met with a glossy press pack and the first of many glasses of champagne. The evening started with some welcoming speeches by Kevin Fewster (Director, National Maritime Museum), Prof Ian Robson (UK Chair IYA2009) and notably Lord Rees (Astronomer Royal) who officially launched IYA UK. We then had time to "network". The invitees were a mix of press, the great and the good of professional astronomers and some carefully selected hangers-on, sorry, amateurs like me. It appears that all those who had received an RAS or IOP grant for IYA were invited, hence my presence.

During our mixing session the hors d'oeuvres were brought round – salmon & asparagus vol-au-vents, fois gras crackers, venison rolls etc., etc., and of course more champagne. There was even a free bar. Must be something to do with getting the press on your side.

Amongst the professionals present were Colin Pillinger and Chris Lintott and a host of Jodrell Bank faces I recognised.

We had a number of events planned for us, including a special IYA planetarium show, visit to the telescopes, a talk on the history of the observatory and a live link-up with the Liverpool Telescope in La Palma.

All-in-all a great night out and an excellent kick-off for the UK celebrations this year.

Paul Whiting

DIARY FOR MARCH

Monday **2nd & 23rd**	**SMALL TELESCOPES OBSERVING NIGHTS** Main Observational targets: Saturn Moon & Comet Lulin ☎ 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 **11th From 7.45PM** **NACTON VILLAGE HALL**	**OASI WORKSHOP** Introduction to radio Astronomy By Dr Laurence Newel, Co-ordinator BAA Radio Astronomy Group. ☎ Mike Whybray [redacted]
Thursday **5th 8.00pm** **12th 8.00pm** **19th 8.pm**	**OBSERVATORY VISITS BY LOCAL COMMUNITY GROUP** University of the 3rd Age University of the 3rd Age **Taster evening** ☎ Paul Whiting FRAS [redacted]

Society Primary Contacts

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

Society Trustees

Mr Roy Adams Mr David Brown Mr David Payne

Society Honorary President

Professor Allan Chapman D.Phil MA FRAS

Observatory Telephone Number

Meeting nights only

[redacted]

John Isaac Plummer, Colonel Tomline's Astronomer Part 11

A1 Miscellaneous Non-Astronomical Publications

Plummer published only two papers dealing with non-astronomical subjects.

In 1890, following the death of Colonel Tomline and Plummer's departure from Orwell Park Observatory, he published a brief letter [1890c] in *Nature* on the subject of Araucaria cones. He wrote the letter in response to an earlier communication from the Duke of Argyll, and in it he assured the Duke that indeed the Araucaria did form cones containing fertile seeds.

In 1910, shortly before retiring from Hong Kong Observatory, Plummer wrote a pamphlet [1910a] entitled *The Origin of Typhoons*. Hong Kong suffered badly from the many typhoons which struck the colony and one of the principal aims of the observatory was to understand the meteorological processes which shaped the formation and evolution of typhoons so as to be able to provide reliable storm warnings to the populace and to shipping. The pamphlet was the only publication appearing under Plummer's name during his time at Hong Kong Observatory (he also contributed to other publications).

Plummer began the pamphlet by noting that although it encapsulated the results of 20 years of study of typhoons at Hong Kong. his ideas on the origin of typhoons were new and had not been exposed to scientific opinion. He suggested, somewhat disingenuously, that the population of Hong Kong, much acquainted with typhoons, was better placed to judge his ideas than scientists located elsewhere who had no first hand experience of the phenomenon!

He noted that Dr Doberck, the first director of Hong Kong Observatory, who held the post from 1883 to 1907, had pursued a programme of investigation of typhoons in which he tried to trace them back to the locations where they first became appreciable, and then studied the circumstances at those locations that were responsible for causing the nascent typhoons to form and grow. (As part of Doberck's programme, staff at the observatory copied meteorological details from ships' logs to build up data on weather conditions at sea.) However, the available data was too sparse to support any definite conclusions and Plummer preferred instead to investigate the phenomenon on the basis of physical principles.

He started his investigation by considering an idealised representation of the Earth, similar to the planet that we know, but covered uniformly by a great ocean, with no land masses. On such a planet, the location directly under the Sun would be preferentially heated. The heating of the atmosphere at the sub-solar location would increase its ability to hold water vapour, and the air would rapidly take up more water vapour from the ocean. Being heated, the air would expand and ascend, lowering the atmospheric pressure. As the planet rotated under the Sun, solar heating would create a trough of low pressure around the globe and reinforce it daily. The position of the trough would alter gradually throughout the year, travelling northward from the winter solstice and then southward again from the summer solstice. Cooler and denser air on either side of the low-pressure trough would move in to fill the void left by the ascending, warmed air, and this would create winds blowing towards the middle of the trough. The cooler air moving in would chill the saturated warmer air, causing rain to fall. The atmosphere would therefore exist in a dynamic equilibrium and winds associated with solar heating would be gentle.

Plummer believed that conditions in the southern hemisphere of the Earth should approximate those which he had described, as the Southern Ocean is only invaded by a relatively small proportion of land mass (Africa, South America, Australasia and Antarctica). Unfortunately, meteorological records were insufficient to confirm his belief. However, the annual appearance of the monsoon in Southern India and its gradual and steady advance to the north provided some verification of Plummer's theory. The annual movement in the trough of low pressure across China, and the existence of portions of the trough across the South China Sea through the Philippines and into the Pacific Ocean also provided verification.

Plummer then reported briefly that the atmosphere was subject to a daily and a half-daily variation in pressure, the former due to solar heating and the latter due to gravity.

The atmospheric trough of low pressure associated with solar heating marked the site of incipient typhoons, but Plummer then noted that it was impossible for typhoons to form on the supposed Earth submerged under a uniform ocean as the atmosphere remained in dynamic equilibrium. He argued as follows that unequal solar heating of the sea and the land was responsible for creating typhoons.

The bulk of the land mass of the Earth is congregated into continents. The interiors of the larger unbroken continents are generally occupied by arid deserts. The atmosphere above such a desert is intensely heated by the Sun during the day and by radiation from the ground at night, creating an area of permanently low pressure. Being far from the sea, the air in the low pressure area is very dry. The dry air rising above the desert spreads out in all directions in the upper layers of the atmosphere, ultimately returning to ground level far from the desert. The atmosphere around the desert is in a state of dynamic equilibrium, with steady air currents not likely to result in the formation of storms. Although the continents all contain mountain ranges, some very high, these do not affect the overall dynamic equilibrium of the continental atmosphere.

Plummer knew of only four regions of the world which regularly experienced typhoons:

- The neighbourhood of Mauritius.
- The West Indies.
- The Bay of Bengal.
- The South China Sea.

All four areas were under active meteorological study, which revealed very different rates of typhoon occurrence. This suggested that the local configuration of land masses played an important part in their formation. All four regions were located to the east or south-east of continental land masses; and all four contained large tropical islands. The region suffering the highest rate of typhoons, the South China Sea, contained four large tropical islands, Borneo, Mindanao, Luzon and Taiwan (Formosa), with Sumatra, Java, Sulawesi (Celebes) and New Guinea just beyond its limits.

Taking Borneo as an example, Plummer noted that the average rainfall was 4 m (160 inches) *per annum*, which encouraged particularly lush forests and a moist atmosphere. During the summer months, the Sun intensely heated the island causing a column of hot moist air to rise above it. However, this rising column rapidly encountered the current of air overflowing above the arid wastes of the Gobi Desert. This current of air was dry and cold and, having been chilled in the upper atmosphere, was gradually sinking. The encounter led to cooling of the rising column of hot, moist air and heavy rainfall. The ascending hot, moist air was swept SE by the current of air. Before the ascending hot, moist air could mix fully with the current of air, the airflow reached the trough of low pressure created by solar heating. The hot air rising above the trough combined with the remaining hot air being swept along with the current of air, and together they presented enough of an upwards thrust of air to funnel in an upwards spiral towards a higher altitude of equilibrium pressure.

The ascending water vapour carried a negative electrical charge whereas the current of air spreading out above the Gobi Desert was positively charged. When they came into contact, the result was thunderstorms, which in turn accelerated the discharge of rain.

Plummer then reviewed the observed prevalence of typhoons. Although meteorological records were too sketchy to be definitive, he believed that there was some evidence of their prevalence some 800 – 1600 km (500 – 1000 miles) S or SE of great tropical islands.

He then described some work that he had undertaken while Doberck was director of Hong Kong Observatory. He made a series of maps, based on analysis of 22 years' worth of typhoon data around the South China Sea, each map showing all the tracks of typhoons observed in one month of the year. The tracks crossed one another in all directions; however by counting all the typhoons which crossed each square degree of the sea in a particular direction, he was able to establish that, in broad terms, typhoons occupied three broad bands across the South China Sea, each associated with one of the islands Borneo, Mindanao and Luzon.

Plummer then addressed the question of what became of the air spilling out above the continental deserts in directions other than S or SE. The overflow of air spilling out to directions from E through N to W generally merged immediately into the general equatorial current, which it merely reinforced. The overflow of air spilling out to the S or SW for most of the year, except when the Sun was near its extreme northern declination, met the equatorial current more-or-less head on. Although this resulted in some turbulence at high altitude, there was nothing to stimulate a circulatory airflow and cause typhoons.

He noted that typhoons were particularly common between Luzon in the Philippines and Annan in Vietnam and struggled to fit this fact into the framework of his previous explanation as follows. Although it was possible to attribute the frequency of typhoons in the area to the proximity of the tropical island of Hainan, to the SE of the continental land mass, the island was sufficiently close to the mainland as almost to be regarded as part of it. He quoted some examples of how the land masses defining the borders of the South China Sea greatly influenced the direction of the winds in that region (causing very significant deviations from the directions indicated by isobars) and went on to argue that the influence of the land masses was so great as to be able to set up a rotatory motion within the South China Sea of the atmosphere around a portion of the zone of low pressure caused by daily solar heating. Such a rotatory movement, once formed, could become very similar to a typhoon, although in general it would be classed as a "less intense depression" than those which originated to the east of the Philippines.

As a footnote, Plummer noted that the paths of warm ocean currents agreed well with the general course of typhoons in the region. He explained this by pointing out that the warmth of a current was favourable to the continued existence of a typhoon (due to the increased heating of the atmosphere directly above it).

Somewhat apologetically, Plummer noted that for the sake of simplicity he had referred in the pamphlet to N and S winds in general terms without making allowance for the rotation of the Earth, which caused a deflection in the apparent direction of the wind. He went on to explain that opposing air currents generally entered the vortex of a typhoon (in the northern hemisphere) as NE and SSW winds (SE and NNW in the southern hemisphere). The NE wind was continually attempting to fill the zone of low pressure at the centre of the typhoon while the SSW wind acted to keep open the vent above the typhoon enabling the escape of hot, rarefied air into the upper atmosphere. The NE wind was the heavier, had a tendency downwards to the Earth and was responsible for the physical translation of the entire vortex; the SSW wind was lighter and had an upwards tendency. The difference in nature of the two winds meant that when a cyclone struck land, the SSW wind was much more damaging to buildings than the NE wind as the former created a pressure from below, which roofs of buildings are not naturally made to resist.

The difference in nature of the two winds also explained what happened when two typhoons came within the vicinity of one another, as happened occasionally. Plummer considered a situation with two typhoons on the open sea, one north of the other by some 500 – 650 km (300 – 400 miles). The SSW hot current would escape to the upper atmosphere through the more southerly typhoon and enlarge it, making it a more intense

depression and would not be available to maintain the more northerly typhoon. The NE current would exert its influence primarily on the more northerly vortex, gradually filling up the associated depression; during this time it would generally not drive the southern vortex, which would be more or less at a standstill. Such interaction between typhoons meant that forecasting the speed and direction of movement of a typhoon was impossible without a detailed knowledge of the meteorological circumstances in a very wide surrounding area: this knowledge was not generally available in Plummer's era.

Similar reasoning to the above explained why a typhoon never exhibited two centres nor divided into two separate eddies: the southern centre would rapidly destroy the northern.

Moving to a close, Plummer summarised the main points of the pamphlet and then briefly gave his views on locations for high altitude observatories to study the meteorological phenomena involved in the formation of typhoons. He pointed out that the Peak of Hong Kong was not a suitable location, and gave his personal favourite locations as North Borneo and Madagascar.

In the final paragraph of the pamphlet, Plummer made a plea for meteorologists to focus more efforts on understanding the large scale properties and movements of the atmosphere. He felt that once the latter were understood, the science of meteorology would be on a much firmer base and the enormous mass of petty detail defining climatic meteorology would naturally fall into place.

Unfortunately, although Plummer presented his explanation cogently and persuasively, it does not accord well with modern meteorological science! According to modern theories (see e.g. [2008d]), there are six main conditions necessary for formation of a tropical cyclone: sufficiently warm sea surface temperatures, atmospheric instability, high humidity in the lower to middle levels of the troposphere, enough Coriolis force to develop a low pressure centre, a pre-existing low level focus or disturbance, and low vertical wind shear. These conditions are necessary for tropical cyclone formation, but they do not guarantee that a tropical cyclone will form.

Warm sea waters are required to sustain the warm, moist core of a cyclone. The monsoon trough, or intertropical convergence zone, is a potential source of vorticity which can create typhoons. This feature is analogous to the feature described by Plummer consisting of the trough of low pressure around the globe created by solar heating. However, although Plummer described the low pressure trough as following the Sun's zenith point, modern theories assert that the monsoon trough follows the Sun's zenith point over land but that over the oceans its movement is much more subtle due to the effects of the ocean in equalising temperature. Other meteorological features are also capable of stimulating the formation of tropical cyclones. The Coriolis force is viewed as an essential pre-requisite to developing rotatory motion around a low pressure area. A minimum distance from the equator of circa 500 km is generally required for the Coriolis force to be sufficiently powerful. The vertical shear must not be too great or it can destroy a forming cyclone.

Maps of cyclone tracks indicate that the role of large tropical islands is incidental in the formation of the phenomenon. Indeed, Plummer himself struggled to fit the island of Hainan into his explanation.

A2 Press Reports Of Plummer's Lectures In Ipswich

A2.1 *The Cometary System*, 02 December 1874

Report in the *Suffolk Chronicle*, 05 December 1874

Mr Plummer took for his subject The Cometary System. *He expressed his conviction that this was a subject which would in the future occupy a much more important place in astronomy than now. From being regarded with something like awe and veneration comets had come to be regarded as things of very little moment, but he questioned whether that was altogether right. Mr Plummer proceeded to give the reasons for his opinion that the importance of the subject would increase, which were found in the fact that the number of comets had increased as optical science had advanced, and that the supply of comets had always grown in proportion to the interest which was shown in the stars. In alluding to the latter point he spoke of the patience which comet seekers must display, and the difficulties under which they laboured. He believed* […text unclear…] *possibly considerably more comets visited the solar system every year, if they could be discovered. Mr Plummer proceeding with his lecture said he believed that though there might be many things in the universe, the use of which was obscure, yet nothing existed in such great numbers, at least, as comets, without having some part to play in the economy of the universe, and he believed comets had a great part. That their part was not known should be a reason for careful research. He wished to be careful to discriminate between what was known of comets and what was merely conjectured. Mr Plummer then described the nature of comets' orbits, and the influence of the great planets in slackening the velocity with which they travelled bringing them within the solar system, and causing them to travel round the sun in much smaller orbits giving examples from well known comets. Our knowledge of these points was pretty complete, but as against this completeness must be put the want of knowledge of a comet's mass* […text unclear…]. *The statement of a former president of the British Association, following no less an authority than Sir John Herschel, that the entire mass of a comet could, doubtless, be enclosed in a snuff box was founded on conjecture only. Mr Plummer next spoke of the materials of which comets were composed, of which we had learnt a little, though it was but a little during the past few years. Two classes of spectra of comets had been observed and this led to the conjecture that it might be possible to classify comets according to the materials of which they were composed, but the extent of their knowledge at present was there were some composed of carbon and some which were not. In conclusion Mr. Plummer alluded to the marvellous and constant changes which comets undergo and remarked that he should have liked to say a few words on the connection between comets and meteors but time did not permit.*

A2.2 *Aurora Borealis*, 05 June 1878

Report in the *Suffolk Chronicle*, 08 June 1878

SCIENTIFIC SOCIETY – At a meeting of the Scientific Society on Wednesday evening, Mr J J Plummer (sic)*, of the Orwell Park Observatory, introduced, in an able paper, the subject of the aurora borealis. Mr Branford Edwards occupied the chair. Mr Plummer having remarked on the want of precise and certain knowledge on the subject compared with what was known of other natural phenomena, went on to speak of the aurora under three different classes, the first of which was simply the auroral arch, devoid of colour, which at a great elevation spanned from east to west. The second was the ordinary aurora, which commenced as a bright arch low down in the north-western part of the sky, vivid streamers sometimes but not always ascending towards the zenith, forming and reforming every few minutes for a considerable time, the duration of* [the] *phenomenon generally being from an hour or two after sunset to an hour or two after midnight. The third class, no instance of which had occurred for nine years, transcended, Mr Plummer said, his descriptive powers. Brilliant streamers, mostly a greenish yellow and red, shot upwards apparently meeting near the zenith, affording a spectacle with which no sunset could vie in definiteness or beauty. Having mentioned that these phenomena were to be witnessed in south as well as north polar regions, and that their supposed connection with arctic conditions was only partially true, Mr Plummer explained that they probably consisted of a discharge of negative electricity, and were most frequently to be seen when magnetic storms prevailed, observations showing that the magnetic storms and the accumulation of electricity which produced the aurorae had their origin in those violent movements of matters which were so frequent when spots abounded in the sun. Passing on, Mr Plummer referred to the spectrum of the aurora, a single brilliant line between the green and yellow, and said it had been a great puzzle, inasmuch as that line was not coincident with any line in the spectrum of any known chemical element at ordinary temperatures. He suggested, as an explanation, that the earth, like the sun, had two atmospheres. In conclusion he spoke of the connection between the movements of the magnetic needle and solar heat. – An interesting discussion followed, and a vote of thanks was passed to Mr Plummer for his paper.*

Report in the *East Anglian Daily Times*, 06 June 1878

A largely attended meeting of the Ipswich Scientific Society was held at the museum on Wednesday evening, the president (Mr Branford Edwards) in the chair, when Mr J I Plummer MA, FRAS, of the Orwell Park Observatory, read a very masterly and comprehensive paper on the aurora borealis.

Mr Plummer commenced by saying that there were, perhaps, few, if any, natural phenomena of the magnitude and splendour of the Aurora Borealis, about which so little was known with certainty and precision, as of the subject of his paper. It was but very lately indeed that it had been found possible to assign to it the proper position and definitely to fix upon the science to which its investigation belonged. Hitherto it had been

regarded as a meteorological phenomenon, but lately meteorologists had succeeded in defining and circumscribing their own science, and in doing so had managed to throw the whole question of meteors upon the care of astronomers, whilst the latter must agree to share equally with them the question of the Aurora. The Aurora might generally be classed in three forms. The first and simplest was the auroral arch. This consisted of a single broad arch not unlike a rainbow in width, but devoid of all colour, spanning the heavens from west to east, and generally situated at a great elevation. This arch had usually a slow motion southward, but he was not aware of its having been known to disappear in consequence of its motion. It had only a short duration, and faded from sight like a cloud dispersed by heat. The second form might be designated the ordinary aurora. It commenced as a bright arch low down in the north-western part of the sky. The portion of the sky below the arch was always of intense blackness, as though it were a cloud, though this is not the case. This stage may last some hours, and may be the whole of the phenomenon visible. But should the causes which produced the display be more intense a further development will take place, and from every portion of the arch vivid streamers would ascend towards the zenith. These seldom last but a few minutes, but they form and reform so that for many hours the northern sky is illuminated by them, and the eye did not tire of watching the ever changing scene. The after development may, however, be of a different character, when waves of light continually pass one after the other with great rapidity across the arch. The duration of the ordinary aurora was various, usually commencing an hour or two after sunset and continuing till an hour or two after midnight. On the other hand, they had been known to last for days, being traceable even at noon. The third class must be seen almost to be credited. None have occurred for about nine years, and he was not sure that they would be visible so far south as Ipswich, and although the beauty of the scene would greatly transcend his powers of description he would attempt it. From every point of the horizon brilliant streamers proceeded upwards till they met at one clearly defined point. Most were coloured greenish yellow and red. This apparent meeting near the zenith was, of course, an effect of perspective, and the term auroral crown had been applied to it. The observer felt himself to be in the midst of a great number of parallel rays which stream away far above him. No sunset, however fine, could vie with it in distinctness or beauty, and the presence of stars shining clearly through the striped canopy added not a little to the glory of the scene. Although called the aurora borealis, the phenomenon was also visible near the South Pole, and there was some reason to believe that an exhibition near the North Polar regions was accompanied by a similar display in the South. There was a general impression that the aurorae were much more frequent in arctic regions, and had some connection with snow and ice; but this was only partially true. Mr Plummer went on to say that the whole phenomenon was electrical, and probably consisted of a discharge of negative electricity, and next dealt with the height above the earth, and inclined to the figures given by Professor Temple Chevallier, of from 72 to 78 miles. In this he spoke only of the arches, as the streamers, he thought, must attain much greater altitudes. The next point dealt with was when the aurora may be most frequently expected. It was clear that there was some connection between magnetic storms and aurorae, and wherever the former prevailed the latter would be seen in greater or less brilliancy, and observations showed that whatever might be the

cause of the magnetic storm and of that accumulation of electricity which produced the aurora it most certainly resided in the sun, and had its origin in some of those violent movements of matter which were so frequent at certain intervals when sun spots abound. These spots were much more numerous at periods of about 11 years. At the present time we were experiencing an over protracted period of minimum disturbance of the sun, and consequently there had been for some years past no aurorae, nor any violent movement of the magnetic needle denoting a magnetic storm. We were now expecting a quick return of all three phenomena for in about a year and a half, or rather more, the time of maximum disturbance should again come round, but there were at present no indication of that, and we might have to wait for some time more. Mr Plummer then contradicted the reports that magnetic displays were accompanied by cracking sounds. As to the seasons, there was no time of the year in which aurorae might not occur. The last point dealt with by the lecturer was the spectrum of the aurora. Here we may mention that Mr Plummer was the first person in England who had thought of applying the spectroscope to the elucidation of auroral phenomena, and he was only anticipated by a few months by Angstrom in Sweden, and Struve in Russia. In the great majority of cases the spectrum of the aurora is of a most simple character, though the interpretation of its meaning was most puzzling. It consists of a single and very brilliant line in the green, or rather intermediate between the green and yellow portions of the spectrum. In all cases this line is present, though it is said to be less conspicuous when others are likewise to be seen. In ordinary cases, however, this line is alone visible, and the puzzling part of the business is that it is not coincident with any line in the spectrum of either oxygen or nitrogen, nor in the known spectrum of any known chemical element, solid or gaseous, at ordinary temperatures. For sometime it was considered likely that as we became more familiar with the spectrum of the gases under different conditions of pressure it would be found that one or other of these bodies would yield a spectrum agreeing with that of the aurora, but some nine years had elapsed since then and still the matter remained as much an enigma as ever. On some occasions and notably when a brilliant red aurora is the subject of investigation, some five or six other and much fainter are seen as well as the puzzling citron line. Several of these Mr Plummer thought, might point to the presence of iron. But still the difficulty remained as to the citron line, and unless it could be identified with some chemical element in some particular form there seemed to be nothing to suggest other than that the earth has two atmospheres as the sun has. There appeared one point at least which must be considered established by the investigation of auroral phenomena, namely that the superior limit of the atmosphere is immeasurably beyond what was formerly believed. In conclusion, Mr Plummer directed attention to the fact that there did exist a connection between the movements of the magnetic needle and solar heat, but we are not yet aware whether this affected auroral phenomena, because the connection at present made out is rather between the heat derived from the sun and the ordinary movements of the needle and not the extraordinary movements which are always simultaneous with the aurora.

A brisk discussion ensued, in which Mr Plummer's theory of a second and higher atmosphere of the earth was criticised, as being contrary to the law of the diffusion of gases. It was, however, suggested that a lighter atmosphere than even hydrogen might

exist, composed of a substance of which chemists are as yet unacquainted, and to which the citron line of the spectrum of the aurora might be due. The popular idea of the common occurrence of aurora, in this district at least, was shown by Mr Plummer to be incorrect, the zodiacal light being possibly mistaken for aurorae at certain times of the year. A vote of thanks was passed to Mr Plummer by acclamation.

A2.3 *Meteors*, 03 March 1880

Report in the *East Anglian Daily Times*, 04 March 1880

At the monthly meeting of the Ipswich Scientific Society, at this Museum, on Wednesday, the President (Mr W Hadden) in the chair, a highly interesting paper on "Meteors" was read by Mr Plummer FRAS, astronomer at Colonel Tomline's Observatory at Orwell Park. Mr Plummer stated that meteors are the only bodies of an astronomical character which are to be met with in the immediate vicinity of the earth. However widespread they may be in the scheme of the universe, and there is reason to believe them to be scattered throughout the entire realm of space, it is only when they enter the atmosphere of the earth that we can have evidence of them, so that our knowledge must be acquired from their behaviour during their short but brilliant career. Although differing greatly in splendour, from minute stellar points, visible only in good telescopes, to large masses almost equalling the sun in lustre, the conduct of all is strikingly similar. They appear suddenly, they traverse a greater or less portion of the sky, generally with considerable velocity, they become suddenly extinguished, or bursting into fragments, with a noise resembling thunder, a like fate befalls the separate portions. The immense majority of meteors never penetrate beyond the outermost portions of the terrestrial atmosphere, the heat that is evolved by friction being sufficient to disintegrate them completely, leaving nothing but the finest dust, which filters slowly through the lower strata. That some, however, do reach the solid earth is now well established, and of late years the records of meteorites that have actually been seen to fall are of almost annual occurrence. Several falls of meteoric stone were particularised by the lecturer, and one of meteoric iron at Rowton in Salor, on April 20th, 1876, which weighed 7¾ lbs and when recovered was still quite warm. This was the seventh instance of meteoric iron being seen to fall from the sky, though falls of stone have been much more frequently observed. True meteoric masses, as seen to fall, or as subsequently found on the earth's surface, may be divided into three classes. The first, called meteoric iron, consists of a peculiar alloy of iron and nickel with only very slight traces of other substances. These are always recovered with a thin black rind or crust, which is no doubt caused by the action of heat. There is also to be found, interspersed through the mass, minute crystals of a phosphide of iron and nickel called Schreibersite. Both these substances are peculiar to meteorites and are not to be found on the earth, except in meteoric bodies. The second class, called meteoric stone, is a volcanic-like rock of greyish white colour also covered with black rind and usually containing a little of the stone alloy. The mass, however, consists of certain silicates of magnesia and alumina as olivine or […text unclear…] *and feldspar. All of these are found among the products of terrestrial volcanoes, and indeed the analysis of some modern lavas shows an almost*

identical composition with this class of meteorites. The third class possesses a more mixed character, and, besides containing more or less of the materials of the other two classes, contains also magnetic pyrites, and a variety of other substances. In all 21 terrestrial elements have been identified as existing in meteorites, but one of these, metallic iron, is very rarely found on the earth in an uncombined form, while such is so frequently the case in meteorites. Having thus explained what meteorites are, the lecturer next proceeded to answer the question whence they come. He stated, that upon any clear night a little patient watching will always be rewarded by the sight of one or more meteorites, but if the watch is kept up night after night for a whole year, it will be noticed that certain nights are specially rich in meteor displays and the records of past observations will show that occasionally these nights will have been distinguished by displays of surpassing splendour. The night of the 13th – 14th November, 1866, will be remembered as one such instance. On that occasion from six to eight thousand meteors fell in from three to four hours as seen from one locality, and the number that eventually fell towards the earth will have many times greater than this. Yet on some occasions, notably in 1799 and 1833, much more brilliant displays were witnessed on this same evening of the year. When a shower is of this character, a fact which may be noted on any evening, it becomes a conspicuous feature. It is that they all appear to proceed from one point in the heavens, those which appear near this point leaving short courses, as if foreshortened in consequence of coming directly towards us. The spectator is evidently in the midst of a shower of fiery bolts, which are dropping all around him as the earth carries him onward. If these were fixed objects through which the earth was running the gauntlet, the point from which they would appear to proceed would be that point to which the earth was tending at the moment, and that this is not the case, shows not only that the meteors had previously a motion of their own, but enables us to tell the direction and velocity of that motion. The next step was to determine the interval of time between successive exceptional displays of the November shower, which was found to be 33½ years. In this way the nature of the orbit pursued by these meteors gradually became known when it was found, chiefly by the labours of Schiapparelli, to be identical with that of a comet which had been visible in 1866. The entire track of this comet is marked out by an annulus or ring of meteors which has been dumping its meteorites on this earth in enormous numbers for a thousand years, and was yet very far from being exhausted, and a dense portion of the ring still existed in the vicinity of the comet itself. It seems highly probable that every comet is similarly accompanied, and it is certain that three others at least, whose orbits actually cross the earth's annual track, give rise to well-known showers of meteors, and it is suspected that a number of comets, which have passed pretty closely to the earth's orbit, are connected with a like number of less perfectly developed showers. At this stage we must ask ourselves the question. Of what nature is the connection between comets and meteors? We have learnt that they move precisely upon the same lines; what we want to know further is whether a comet is nothing more than a large meteor or a collection of small meteors or whether it is a foreign body that has attracted these attendants to itself, in its wanderings through space. Each of the former suppositions has been advocated, but the latter approved itself as more in accordance with the strange and varied appearances presented by comets. There was nothing improbable in the comet doing this, especially if it

could be shown to be a body of considerable mass. It was well known that there were many meteors which did not group themselves into particular showers, but were irregular or sporadic, and such would be quite liable to be picked up by the passing comet when beyond the region of the sun's more powerful attraction. Moreover, this hypothesis explained how such incongruous objects came to be associated together, for our knowledge of the chemical constituents of comets and their physical conditions certainly did not point to any community of origin in these two classes of bodies. As there is no direction in space to which comets did not penetrate, so also there can be no region where the meteor may not be found, and the latter must of course undergo the same vicissitudes as the former. Thus occasionally they would have the fortune to pass near one or other of the major planets of the solar system, and would suffer such diminution of velocity as would cause them to pursue in the future closed orbits. This had been the case with Tempel's comet and its attendants the November meteors – which had been made permanent components of the solar system by the attraction of the planet Uranus. The reason why the meteors cover the whole track of this comet, producing thereby an annual shower, was because of the whole of the bodies forming the original group some were gaining slightly on the rest, and thus a tendency towards an equable distribution arose which may be completely effected in course of time. In conclusion the lecturer referred to the class of sporadic meteors and their supposed origin. He pointed out that the strong resemblance of many of them to terrestrial lavas gave strong support to the theory advanced by Dr Hall that they may have been ejected from volcanoes upon the earth at some remote period when the explosive forces were much greater than at present. The principal difficulty in accepting this solution was that one of the invariable components of aerolite, nickel iron, was nowhere found in any quantity upon the earth. Still, all our knowledge was in favour of a volcanic origin for these bodies. Within the last year or two it had been found possible to make this peculiar alloy artificially by a process not unlike what would take place within the crater of a volcano, and this artificial alloy, when slightly acted upon by acids, was found to be etched upon, the markings closely resembling the Weidmann-statian [??? text unclear] *which are quite characteristic of meteoric iron, so that the formation of both the main classes of meteors is now to be traced to the main agency. He was strongly of* [the] *opinion that eventually the suggestion of Dr Hall would be generally accepted, and that such difficulties as at present were opposed to it would be found capable of explanation. At the same time, it must be remembered that it applied only to a numerically small class of meteors and left the origin of the components of those following the tracks of comets as little explained as before. Unfortunately we did not possess a specimen known to have been originally a cometic meteor, so that as far as we know at present, these might be of an entirely different character, appropriate to an entirely different origin.*

At the close of the paper, which was constantly applauded, Mr Plummer was subjected to a perfect battery of questions relative to comets, meteors, sunspots, etc. A fragment of a meteor given to Mr Plummer by Mr J Breen of Cambridge, was handed round the room, and its peculiar structure observed. Dr Taylor pointed out that this supposed meteor was exceedingly like the nodules of iron pyrites, frequently called thunderbolts in Suffolk, but

which were not meteors but formed mechanically by aggregation. Mr Napier, PCS, of Bramford, promised to analyse the meteor, and ascertain its actual elements. On the motion of Mr Napier, seconded by Dr Taylor, a cordial vote of thanks was passed to Mr Plummer for his exceedingly interesting address.

A2.4 *Stars*, 03 December 1890

Report in the *East Anglian Daily Times*, 04 December 1890

IPSWICH SCIENTIFIC SOCIETY

At the usual monthly meeting of the Ipswich Scientific Society, held at the Museum on Wednesday evening, Mr J I Plummer, MA, FRAS, read a paper entitled Stars: Their Distances and Actual Movements. *The chair was taken by Mr Henry Miller, jun., and there was a full attendance of members. At the opening of the meeting, before the special subject was introduced, Mr W Vick exhibited the photograph of a solanum, covered with ice on both stems and united at the top, which was rightly described by the Chairman as a curious and beautiful object, and also some of the splendid views of Gifford's Hall, which was recently visited by the members. The secretary of the Ipswich Photographic Society wrote that on the 7th of January an interesting lecture would be given, in connection with their organisation, by Mr H M Smith, of the Eastman's Photographic Materials Society. He invited the attendance of members of the Scientific Society, and it was resolved to defer the next monthly meeting, which was fixed for the same date, in order that this invitation might be accepted. Mr Plummer, who was welcomed with the heartiness due to his high reputation as an astronomer, then read an exceedingly interesting paper upon the subject announced, under the title (which he himself preferred) of Stellar Parallax and Stellar Motion. It is hardly possible, however, to summarise a lecture which was itself a close summary of facts relating to this branch of science, and we may perhaps be allowed to say that it pre-supposed a more intimate acquaintance of the elements of astronomy than the majority of newspaper readers would profess. But Mr Plummer's conclusions, which were characterised by an earnest and even reverent enthusiasm, showed very clearly the wonderful fascination of a study which should be more generally followed. There was reason to rejoice, he said, in the success that astronomers had achieved, and in the special providence which had placed the inhabitants of this globe upon a spot so constituted that it would seem to afford a better chance of investigating these questions than any other that could be conceived of. If it were not intended that man should solve such questions, how easily might he have been placed in circumstances under which their solution would have been would have been absolutely impossible. It was manifestly the Divine intention that man should so occupy himself. There was a time, within his memory, when a view of the aim of human existence not less exalted than this was common in this country; it might still exist possibly, although seldom heard of now-a-days; but they had to look abroad – to France, to Germany, and to America to find a practical expression for this reverential feeling for creation of which continued astronomical study was the outcome. – At the close, the Chairman said there could be but one opinion as to the merit of the paper, and*

he invited members to make the most of Mr Plummer now that they had him present. – A discussion followed, in which several members showed a keen appreciation of the facts laid before them, and a very cordial vote of thanks was passed on the motion of Mr E P Ridley, seconded by Mr A Harwood. – The question of holding a conversazione in February next was referred to the Committee, with instructions to suggest a definite proposal for consideration at the next meeting.