NEPTUNE

75th Anniversary Edition

CAMBRIDGE UNIVERSITY ASTRONOMICAL SOCIETY

Cover Photo – The Orion Nebula (M42) by James Rawson

WELCOME

Chair's Address:

As we grind through another year at Cambridge, the current committee shall bid farewell to their office. It has been a busy year – we've invited many renowned researchers in our weekly talks and many of them are incredibly successful. We've had a garden party right after the last Tripos (the next one is around the corner, but, as suggested by The Hitchhiker's Guide to the Galaxy, don't panic!) and the 75th anniversary dinner, which shall be well furnished with the early history of CUAS and happens to coincide with the publishing of this issue of *Neptune*. Moreover, we shall not forget the numerous observation nights, ObsDemos and ObsTests, and the hard work devoted by our ObsSecs into these sessions. We've even had a night punting session!

Now the torch must be passed on. On behalf of the outgoing committee, I would like to wish the new committee – Hannah as chair, Andrew as secretary, James as treasurer, and Harry and Dan as ObsSecs – best of luck in the forthcoming year. It will surely be another exciting year in the history of CUAS.

I've always been grateful to see so many people – including a child who frequents our talks with his father – are interested in astronomy and the astronomical society. I'm not an astrophysicist by training, but whenever I look at the starry sky I would have been enthralled by its immense beauty and mystery, and I trust many of you, the readers, do share my feeling. The beauty of astronomy cannot be fully described with words, but we shall present bits and pieces of it in this issue of Neptune. We would also like to share some of the interesting stories that happened over the past year. Please read on, and hope you have fun!

Siyang Fu (Chair 2017-18)

2017-18 Committee:

Chair:	Siyang Fu
Secretary:	Li Xin
Junior Treasurer:	Andrew Sellek
Observation Secretaries:	James Xiao
	Harry Metrebian
	Harry Rendell
Events Officer:	Sophie Baldwin
Membership/Website:	Zhipeng Wang

President: Dr Mike Irwin *Senior Treasurer: Jonathan Shanklin*

Editor's Note

Well here I am again, editing *Neptune*. How can this possibly be, I hear no-one cry? Well, I'm going to tell you anyway because I need something to fill this space.

When I took over as chair for 2016-17, I was determined that those traditions that were no longer always being observed, such as *Neptune,* would not be absent on my watch. Consequently, such no-one had decided to run for editor, I agreed to add editing the magazine to my repertoire of responsibilities. Especially since in recent years, this has become an annual job (In the days before email was used so widely, *Neptune* was once a monthly newsletter including previews and details of planned events, observing highlights for the coming month, irreverent banter and even puzzles! Now it has taken over the place of the old annual publication *Pulsar*.) Completing the magazine involved much begging for contributions and late nights editing once I had got bored of writing lab presentations (one of main benefits of taking up astrophysics has been no more labs!). But finally, I had something ready in time for the AGM and annual dinner, though I don't yet know if anyone has gotten around to reading it.

Appointed to the committee again, this time as treasurer, I was just as eager that things wouldn't disappear. To ensure nothing was forgotten or not known about, at the first committee meeting I was armed with a list of things to discuss that was certainly not an agenda, for that was not my place (I give Hannah full permission to confiscate any such papers found in my possession again to stop me interfering*). I raised the question of *Neptune* – someone would have to write it. All eyes turned on me and it dawned on me what I had done. I was promptly volunteered by all 7 other members of the committee. I agreed on the proviso that everyone else must contribute something – well 5/8 ain't bad. And that is how I came to be doing this job again.

In all honesty I'm pleased with this issue. It's a pleasure to show off some of the excellent astrophotography of our members – hopefully, unlike last year, I haven't spelt it as "astrophotgraphy" in any article titles. We've also got a good variety of interesting features articles, including some good observing challenges for you to try. We've also bribed James (with doughnuts) not to do his legendary eyepiece talk at this year's dinner, so in one of his last acts as ObsSec, he's written it up as an article to be preserved for all time, though I hope he may still join us for obsnights on occasion where he can corner unsuspecting freshers who dare to "nag him about naglers".

So, to echo what Siyang said in his address, do read on and enjoy. Finally, though I'll try and refuse, if experience has taught me anything, it's that I'll be back on these pages this time next year. If not, good luck to my successor as editor, I hope the members shower you with material!

Andrew Sellek (Neptune Editor 2016-18)

**So long as she reads them fully afterwards!*

In Memoriam: Donald Lynden-Bell (1935-2018)

We were saddened to hear that Professor Donald Lynden-Bell passed away peacefully last month, aged 82, after a short illness. A CUAS member as an undergraduate in the 1950s, he first addressed the society as speaker in 1966 while working at the Royal Greenwich Observatory. He returned to the city in 1972 as the first director of the newly amalgamated Institute of Astronomy. At this point he was elected to the position of President of CUAS, one of the senior members who guide the student committees in their work. He remained in this post until 1995. Professionally, he was a renowned theorist who contributed to many fields, most notably by pioneering the model of active galactic nuclei (quasars) as powered by the highly efficient radiation of gravitational energy lost by matter accreting onto a supermassive black hole. Professor Lynden-Bell last spoke to the society in 2013 when he attended the 70th anniversary dinner (pictured below). He will be sorely missed by all those who had the fortune to know him.

James Lancashire has kindly provided the following links to speeches, including by Professor Lynden-Bell, at the 50th anniversary celebrations:

https://vimeo.com/258355168
https://vimeo.com/258355627

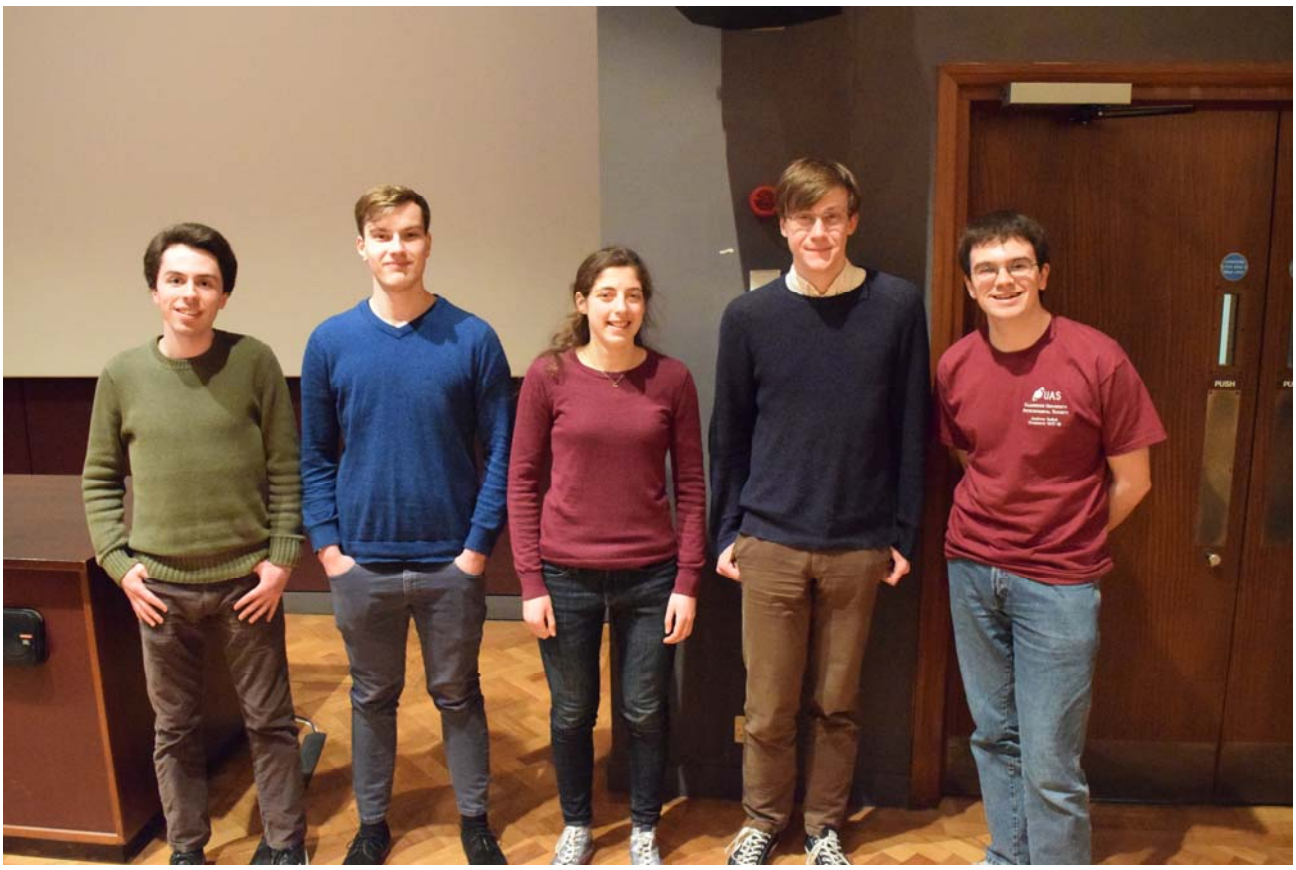
Pictured: Donald Lynden-Bell (L) attends the 70th Anniversary Dinner (from CUAS website)

2018 AGM

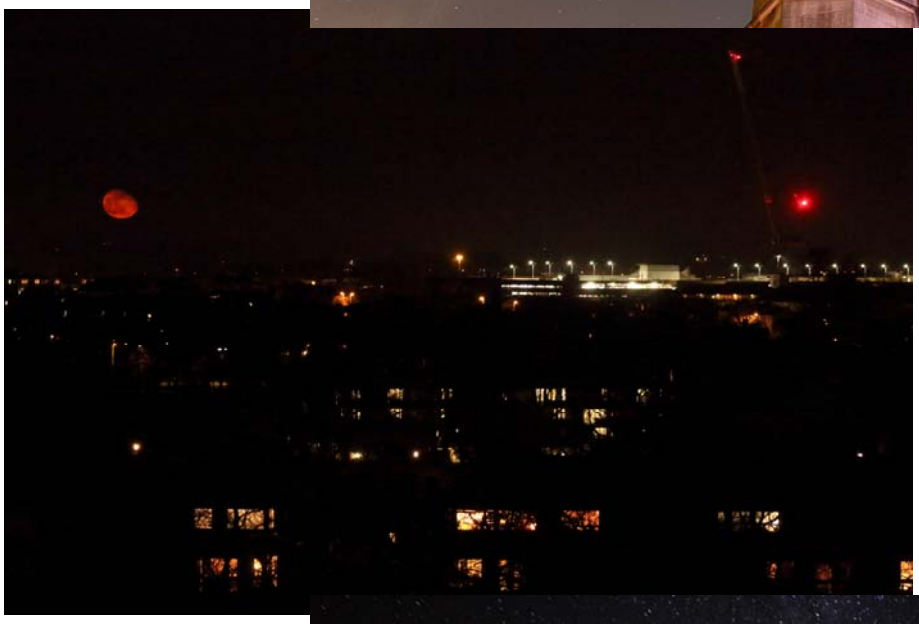
Stop the press! (This was genuinely the thing delaying completion of the magazine).We are delighted to be able to bring you the results of the 2018 AGM.The 2018 committee will be:

Chair:	Hannah Sanderson
Secretary:	Andrew Sellek
Junior Treasurer:	James Rawson
Observation Secretaries:	Harry Metrebian
	Daniel Mortimer

Here are the new committee looking excited to be in the job!



L to R: Harry Metrebian, Dan Mortimer, Hannah Sanderson, James Rawson, Andrew Sellek



Top: Trinity Queen's Gate
— Toby Henley Smith

Left: Moonrise Over Cambridge
— James Luis

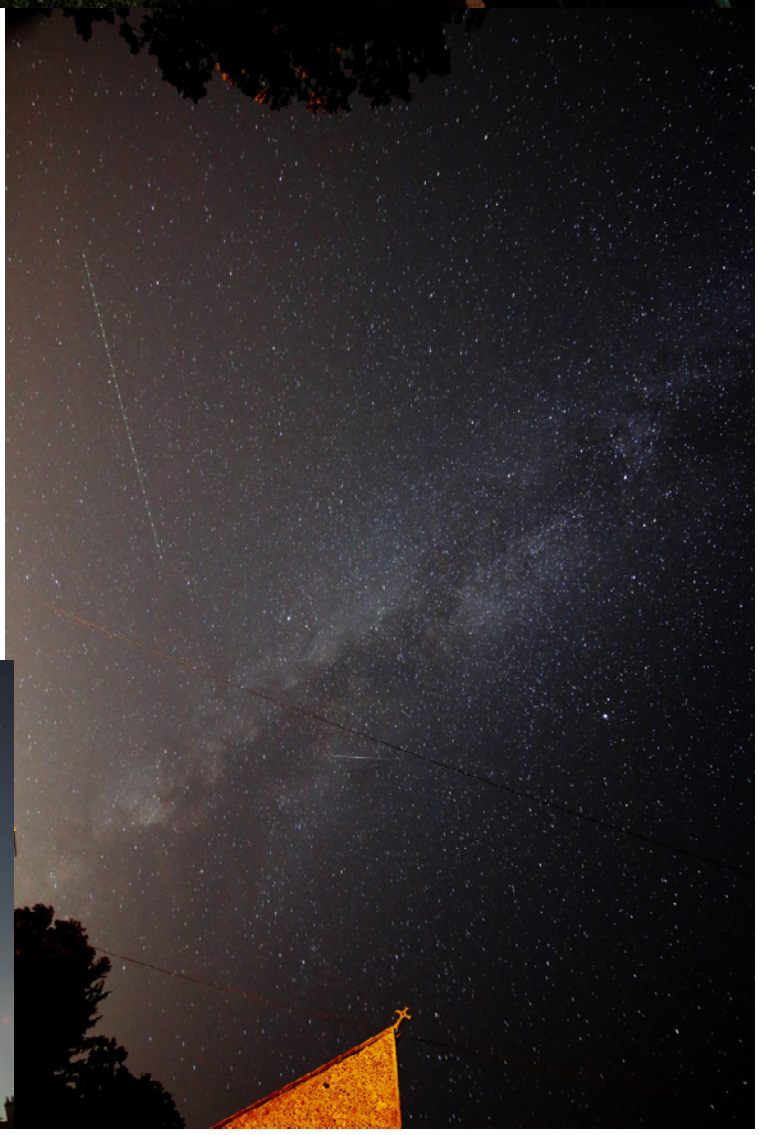
Bottom: The Milky Way over Grantchester
— James Luis

WIDEFIELD PHOTOS

Top: The Northumberland Dome — James Luis

Right: The Milky Way Overhead — James Luis

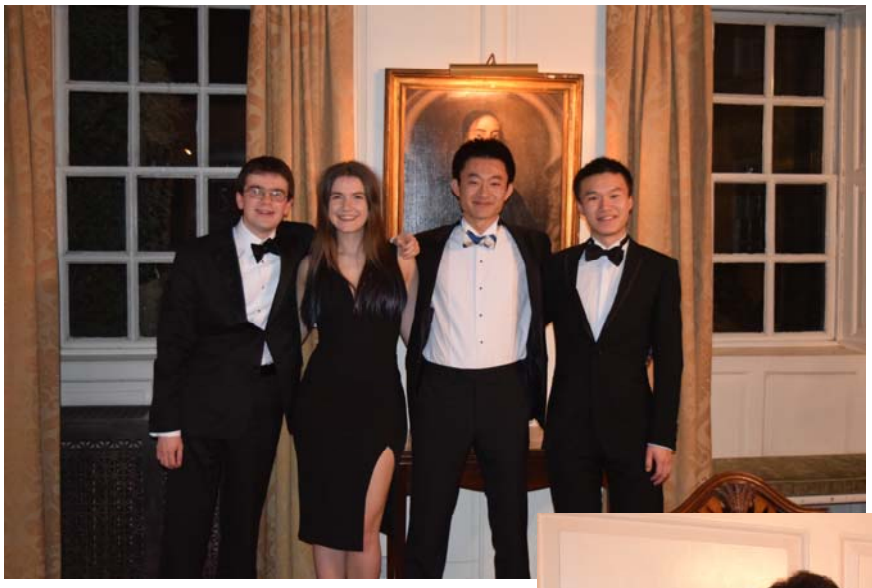
Bottom: Orion above Trinity Great Court — Toby Henley Smith



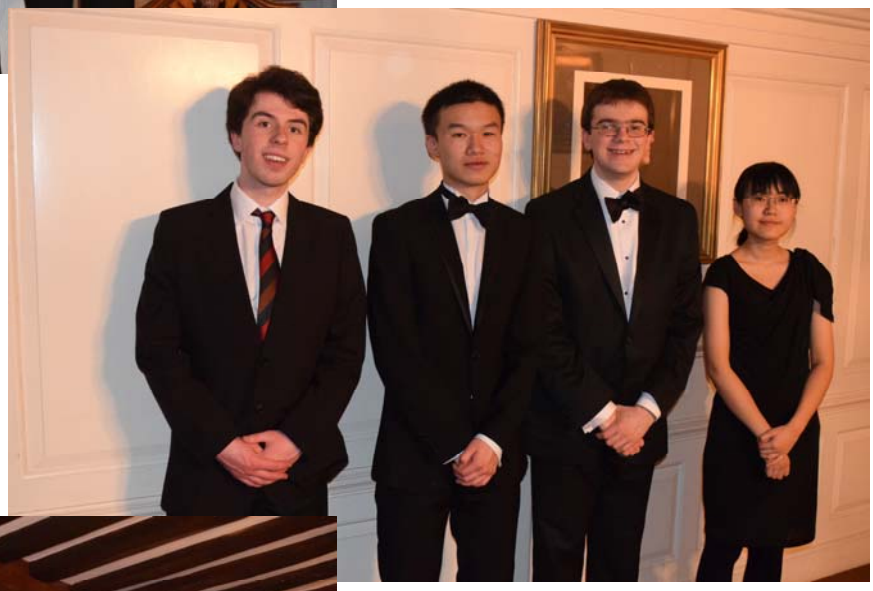
2017 Annual Dinner

The 2017 CUAS Annual Dinner was held on 10th March in the Mountbatten Room at Christ' College. An excellent evening was had by all – see below for some photos.

This year's dinner is being held in Queens' College on 9th March to celebrate the 75th anniversary of the founding of the society in 1942. We are looking forward to welcoming many members from across the years to this event.



L: The Outgoing 2016-17 Committee
(L to R: Andrew Sellek, Helen Piatkowski, Xiao Lin, James Xiao)



R: Some of the Incoming 2017-18 Committee
(L to R: Harry Metrebian, James Xiao, Andrew Sellek, Li Xin)

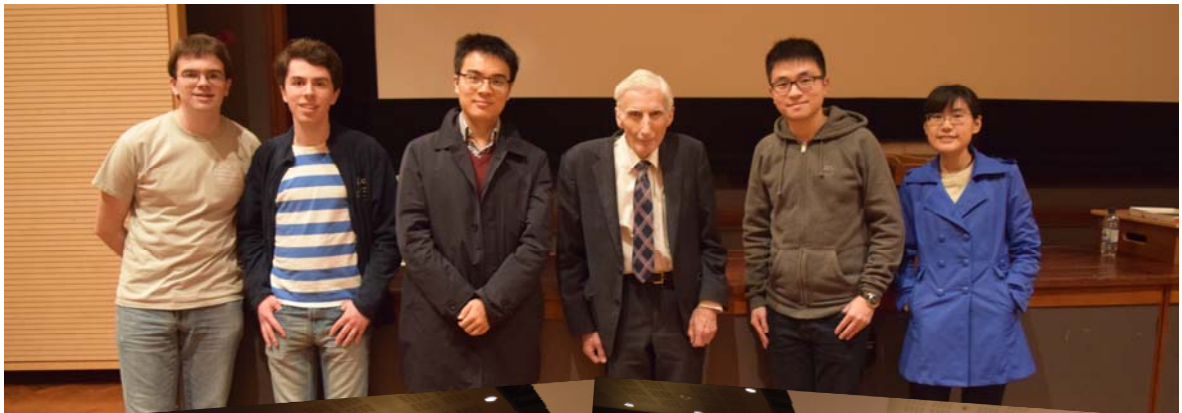
L: Everyone joins for a group photo

Freshers' Events

We opened the year with a successful Freshers' Squash which saw around two dozen new members people competing in a multiple choice quiz at the Anchor. They all dodged the most dubious options such as "James' Doughnut" – a proposed name for M57!

Then, on the 10th October we had the pleasure of welcoming Lord Martin Rees, the Astronomer Royal since 1995, as our opening speaker for the season. A long-time supporter of the society, Lord Rees chose to speak on the topic "From Mars to Multiverse" in which he took us on a grand tour showing humanity's place in the universe. He covered many exciting themes such as the latest in the search for exoplanets all the way up to the origin of the fundamental laws governing the universe on the largest and smallest scales. He even dropped a few hints about a major discovery which was announced the following week – the discovery of the first neutron star merger seen by gravitational waves by the LIGO collaboration – and its importance for the creation of heavy elements in the Universe. As an eminent speaker, Lord Rees drew in the biggest crowds that a CUAS talk has seen for a few years, with around 160 people attending.

Despite conflicting forecasts, the ObsSecs managed to pick a clear night for the Freshers' Obsnight. Finally, we went night punting. Over 130 people signed up for the 36 places – we shall have to run another similar event soon!

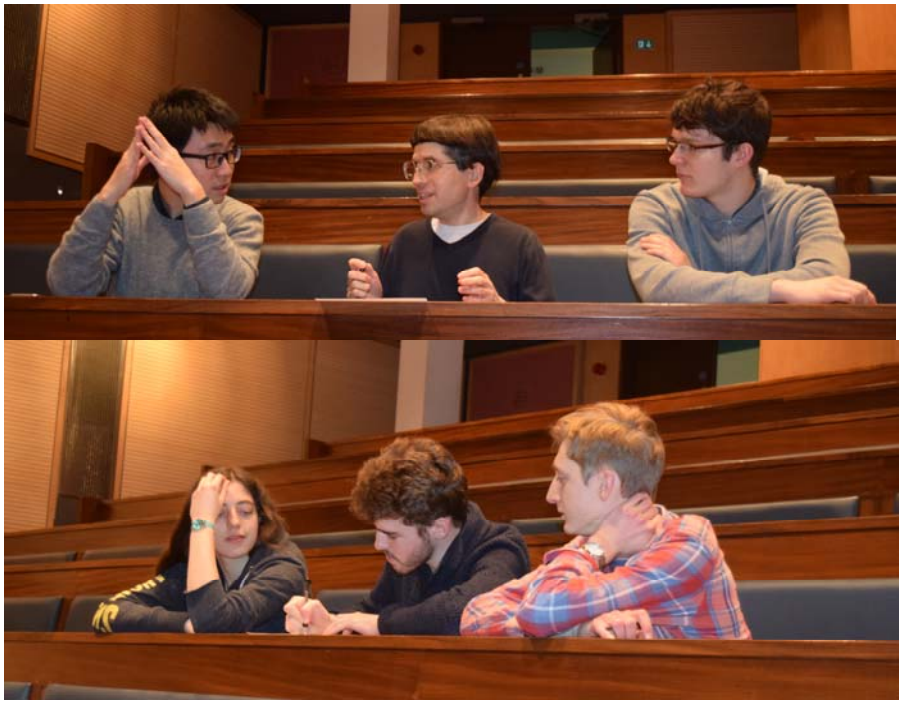


Top: Some of the committee got to pose for a photo with Lord Rees at the end!
Left: Lord Rees showed us his a photo signed by a collection of Apollo astronauts.
Right: The BMS lecture theatre was packed with interested members and new faces!

QUIZ NIGHT

In January we held an astronomical quiz night. Harry Metrebian and Andrew Sellek devised a tough set of 42 questions to test the participants' knowledge of the latest events in astronomy, science fiction, the history of planet discoveries, songs with astronomical titles, space exploration, things that have been mistaken for aliens and events we could look forward to in the future. Of the teams that rose to the challenge, "Team Tatooine" emerged victorious, spurred on the knowledge of their star player, Joseph Myers. Many of the contestants joined us for a drink at the pub after with a free drink for the winning team. Why not see how you would have done on our "Astronomy in 2017" round?

1. What major object did the moon occult on 21st August?
2. In February, the discovery of a large number of planets in the TRAPPIST-1 system was announced; how many planets have we detected there?
3. What significant event happened in the galaxy NGC 4993 roughly 130 million years ago?
4. What object collided with Saturn on 15th September?
5. Why was the Hubble Space Telescope scheduled to observe planet Kepler-1625b in October?
6. In July, astronomers announced the discovery of the smallest known what?



ANSWERS: *1. The Sun; 2. 7; 3. A Neutron Star Merger or "Kilonova" seen in gravitational waves and optically; 4. The Cassini Spacecraft; 5. To assess an exomoon candidate; 6. Star (EBLM j0555-57Ab)*

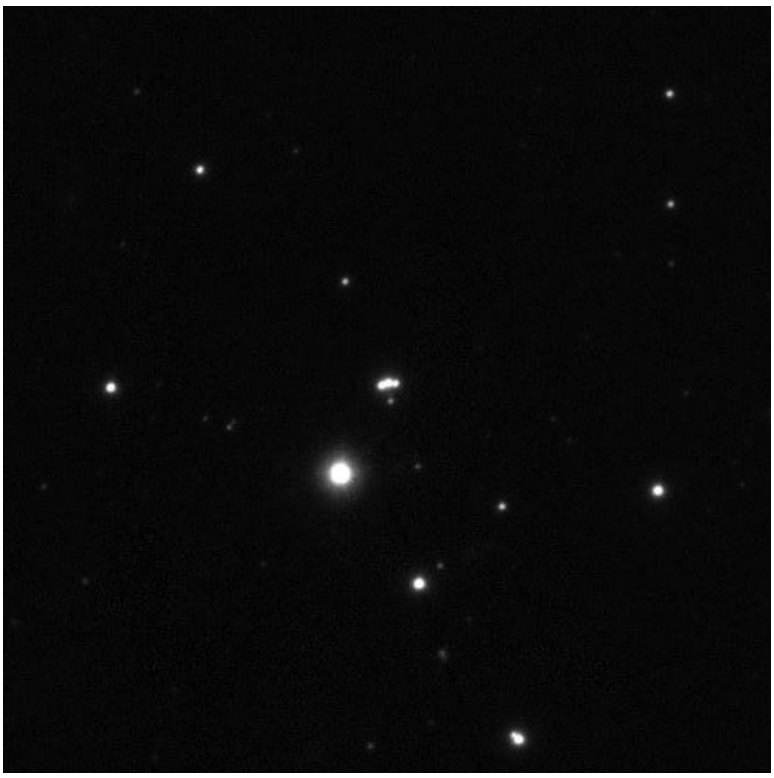
Top L: The Milky Way in Cygnus, Top R: The Andromeda Galaxy M31,
Mid R: The Dumbbell Nebula M27 – all James Rawson

Mid L: The Cocoon Nebula, Bottom L: The Pleiades M45,
Bottom R: The Heart and Soul Nebula (with the Double Cluster) – all James Luis

Observing an 11 billion-year-old quasar with the Northumberland telescope

Quasars are among the most luminous objects in the universe; they can emit thousands of times as much energy as the Milky Way. They are now known to be rapidly accreting supermassive black holes in the cores of distant galaxies. Owing to their extreme brightness, quasars can be observed at extraordinary distances: the most distant known quasar, ULAS J1342+0928, is so far away that we see it as it was just 700 million years after the Big Bang.

A galaxy directly between the Earth and a quasar can act as a gravitational lens and split the quasar's light into multiple images that are brighter than the quasar would appear on its own. In July last year, a quadruple gravitationally lensed quasar was discovered in data from the Pan-STARRS sky survey. This quasar has a redshift of 2.341, corresponding to a distance of around 11 billion light years when the light was emitted, and perhaps 19 billion light years now. The quasar's designation is J014709+463037, but it has been nicknamed "Andromeda's Parachute" after the constellation it is in and the shape formed by the four images. The lensing effect makes the quasar unusually bright: the discovery paper suggested that the combined brightness of the four images was magnitude 14.5. This makes Andromeda's Parachute the brightest known gravitationally lensed quasar.



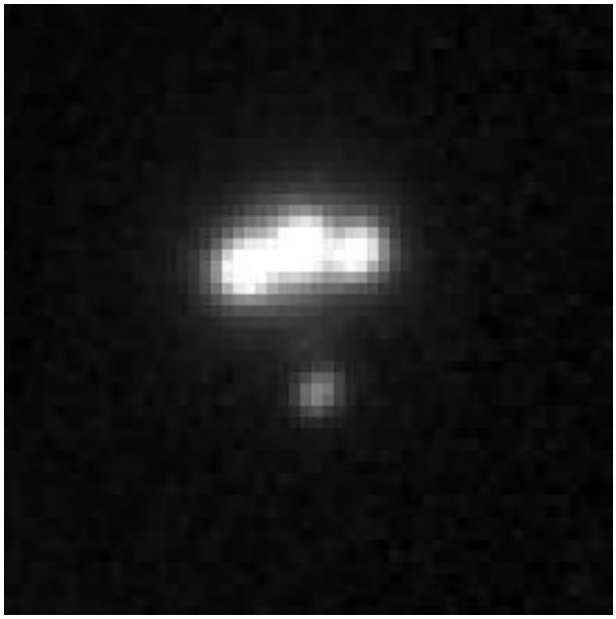
R: The field containing the quasar

When I saw the news of this discovery, I realised that Andromeda's Parachute ought to be faintly visible with the Northumberland telescope, although it would be difficult if not impossible to discern its multiple nature. My first opportunity to observe it came in the early morning hours of 20 August. Pointing the Northumberland at the correct coordinates is easy, and once in the right field I used a printed image of the region around the quasar, with some star magnitudes marked, to locate it. Averted vision was necessary to see it, and I estimated its magnitude as 15.2. At a magnification of 305x it did not look any different from a star, although the seeing was not particularly good. Stars down to magnitude 15.6 were visible in the field. Andromeda's Parachute is the most distant object I have ever seen, and probably the most distant object that has ever been observed with the Northumberland telescope.

I have since observed Andromeda's Parachute on two more occasions, both in October, at which several other people also got the chance to see it. The quasar was noticeably brighter – around magnitude 14.9 – in October than it was in August. This is not surprising, as quasars are usually variable in brightness, and the discovery paper's estimate of 14.5 may be further evidence for variability.

The brightest known quasar, 3C 273, has a magnitude of around 12.9, meaning it is visible with an 8-inch telescope. It is in Virgo so is well-placed for observation in the spring, and it is a standard target at CUAS observation nights.

Harry Metrebian (ObsSec 2017-18)



L: The quasar up close showing its distinctive parachute shape and four separate images

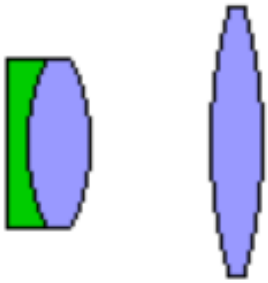
The pictures in this article are from the Pan-STARRS 1 Survey. The Pan-STARRS1 Surveys (PS1) and the PS1 public science archive have been made possible through contributions by many institutions to the PS1 Science Consortium. Details of these institutions can be found here: https://outerspace.stsci.edu/display/PANSTARRS/PS1+Science+Consortium+-+PS1SC

Eyepieces of Northumberland

Eyepieces are crucial in obtaining a view in a telescope. The Northumberland is not different, and the current collection boasts a wide range of designs and focal lengths, old and new.

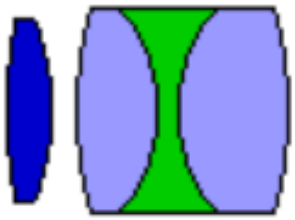
Eyepiece designs consist of a *field lens* and an *eye lens*. The field lens is placed near the focal point of the telescope's objective (20-feet away from the 12-inch achromatic doublet in Northumberland) and the eye lens placed near the eye. The telescope focal length, divided by this focal length of the eyepiece, gives magnification. Common eyepiece sizes are 1¼" and 2" barrel diameter.

The Kellner – The lowest magnification eyepiece is the 2" 60 mm Kellner eyepiece (marked with a 'K'), giving 100x power. This consists of a single-element (individual glass piece) field lens and an achromatic doublet (2-element) eye lens for a total of 3 elements. 20 years ago, these eyepieces were very common and offer a reasonable 45° apparent field of view (AFOV) i.e. the size of the illuminated disc looking through the eyepiece. The achromatic doublet also corrects for some colour distortion.

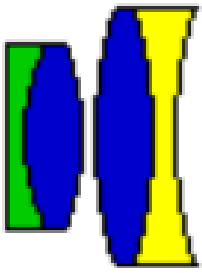


Kellner

The Orthoscopics – The range of 1¼" Orthoscopic eyepieces complete the rest of the collection from 12 mm to 40 mm in the 'Northumberland Eyepieces' box. These use a 3-element triplet field lens and a single-element eye lens. Dating back from 1880, they are less commonly used nowadays since the advent of more exotic designs. The triplet lens group allows for excellent optical correction and extremely low distortion views and they are fantastic for viewing planets, and many still prefer these for this purpose. A major downside is they have a low AFOV of around 40°, which is like looking through a drinking straw, thus not useful for viewing most deep sky objects.

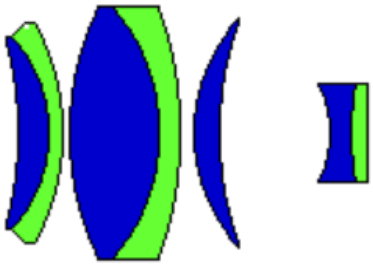


Orthoscopic



Plössl

The Plössls – These are a collection of Meade 4000-series Plössl in a heated box in the SW alcove. These are 4-element designs featuring two reversed achromatic doublets for field and eye lenses. These were relatively rare and expensive until their simple design and relatively wide AFOV of 50-52° became manufactured widely in China. Today they are bundled with most telescopes sold and are the most common eyepiece. The 56 mm 2" Plössl gives the largest true field of view possible in Northumberland – 0.48° at 109x. They are very suitable for deep-sky observation.



Nagler (Type 1)

The Ultrawide (Nagler) – Last year CUAS purchased an additional eyepiece for the Northumberland dome. This is a Skywatcher Nirvana 28 mm 2" eyepiece with an astounding 82° AFOV. This has 6-elements in 4 groups and offers 'spaceship-like' views of objects. In the 1980s the original 'Nagler' eyepieces were invented, which contained what is essentially an integral Barlow lens to increase the focal length and image circle, which was then folded back in with the eye lens to create huge fields of view, with very good correction. With more modern coatings, glass and mass production, they have got better, smaller and very slightly cheaper. The great advantage of these eyepieces is that one can observe the same true field of view as a longer focal length Plössl but at a higher magnification, giving better contrast. The views through this eyepiece can be spectacular and even if you've seen an object many times, one look through an ultra-wide can be entirely something new.

Currently 100° and even 120° AFOV eyepieces exist with ludicrous prices to match. Perhaps they will be used with Northumberland in the future, but for now, this concludes the 'eyepiece talk'.

James Xiao (ObsSec 2015-18)

Astronomy in the Twilight and Daytime?

It is an often-repeated story that Mercury is very difficult to see. I became aware in 1990 when I was trying (unsuccessfully) to locate a comet in the twilight that this is not invariably the case. While scanning the skies for the comet I became aware of something that looked generally like Venus though not nearly as bright, which could best be described as 'conspicuous' rather than 'hard to see'. Mercury seemed the best bet as to what it was and this was confirmed on my return home. I realised that there is a tradeoff between elongation and brightness, and that greatest elongation is not necessarily the ideal time. 4 factors determine how easy it is to see Mercury:

(i) where it is in its orbit
(ii) the season of the year
(iii) how long after sunset
(iv) and crucially, how clear the atmosphere is down to the horizon

Going by memory and having no pretensions to accuracy, the elongation was of the order of 14 deg., but the twilight has dimmed considerably by the time the altitude got to around 5 deg. Some years later (I believe when there were a number of bright planets in the same part of the sky) I was also able to rouse the neighbours and point to the planet (no careful directions needed!) and tell them they could join the exclusive club composed of those who have seen Mercury.

Another thing I did a few years ago was my 'daylight astronomy project'. It is well known that Venus can be seen in daylight but is there anything else? The answer is that you can see Jupiter quite clearly, and I even saw it once while the setting sun was still visible. This is a very strange experience -- it seems somehow wrong that you can do this (though I guess this happens with comets -- unfortunately I was away at the critical time for comet McNaught). Of course you have to be attentive to precisely the right place in the sky for this, just as with Venus. The next obvious question is 'what about Sirius?', the answer to which seems to be that you cannot see it at sunset in the usual sense, but you can get a kind of feeling that there is something in a particular place, and confirm it with binoculars.

Professor Brian Josephson

Left: Comet Hale-Bopp as seen from Cambridge on 15th April 1997
- Brian Josephson

Below: The Northern Limb of the Moon seen through the Northumberland Telescope
- James Rawson

THE VOYAGES OF A CUAS TIE, PART THE NTH

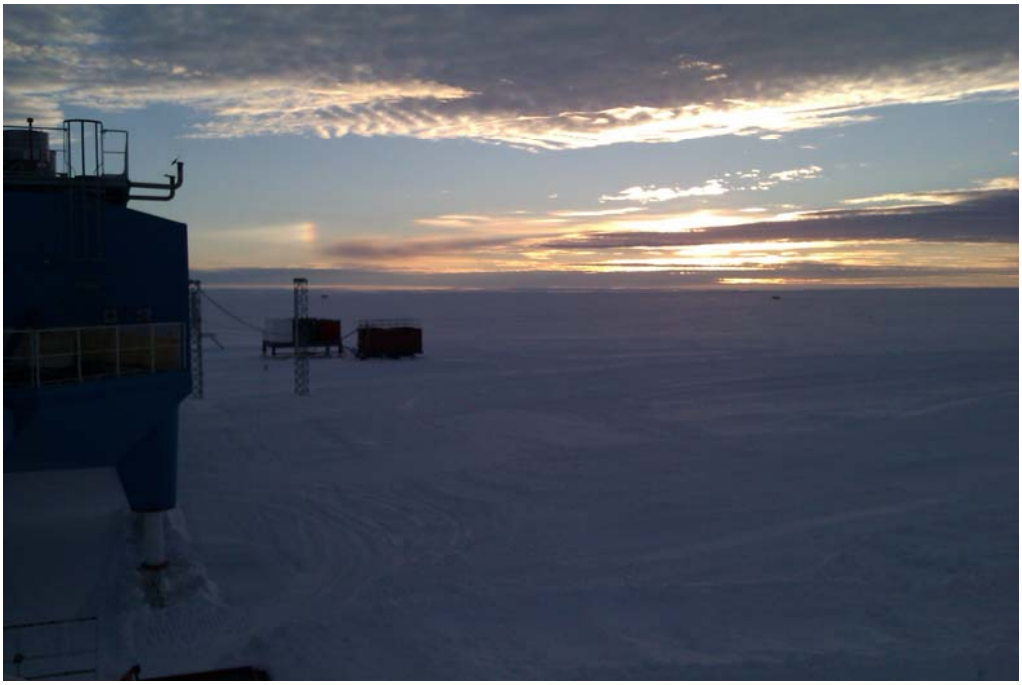
In some early editions of Pulsar (a forerunner of Neptune) I wrote about the voyages of my CUAS tie, which went with me on my first trip to Antarctica. It has come to Antarctica with me again, so provides an excuse for some narrative, though there is not much to report astronomically speaking. My destination on this voyage was Halley Research Station on the Brunt Ice Shelf. Halley is effectively in the middle of an almost endless white desert where there is little evidence of life. It is not quite as flat as the Cambridgeshire fens, but the hills are gentle and rise no more than 10 metres from the mean level. The station has been in the news recently, originally because it was being moved due to the possibility of the ice-shelf calving at some point in the future. Things got more serious as the move progressed when a new crevasse was discovered which was tracking towards the route between the old site and the new one.

My role on the ice is as a meteorological observer, making the routine synoptic observations that are used in weather forecasting and climate research, with additional observations made for aircraft operations. In addition as an ozone specialist I am making calibration and routine observations with the existing Dobson ozone spectrophotometer and advising on the commissioning of another one that has been automated. We hoped that this would run through the winter unattended whilst being powered by an autonomous micro-turbine generator, however the turbine is being shipped back to Cambridge for further testing.

On this trip my first view of the southern skies was from Cape Town. Perhaps not surprisingly from a big city only the brightest stars were visible. Sirius and Procyon were obvious, with Canopus the only southern star that was readily seen. The Southern Cross was low in the south and hidden by glare, but it will be higher when we return in mid February. Our flight to the Antarctic was very luxurious in a chartered Boeing 757 that was more frequently used by pop stars and where the worst seating was business class.

The plane landed on wheels on a blue-ice runway at the Russian station Novorasalevskaya, where we quickly transferred to another plane for the flight to Halley. We were now well inside the Antarctic circle with no prospect of another sunset until it was time for us to leave. The only other astronomical object seen during my stay has been a half moon, which I've spotted a few times. I took down my short-tube 90mm refractor for solar observing, though with solar minimum approaching there weren't many sunspots on view. Very often the seeing was quite poor, though this may have been a side effect of observing through the station windows as it was often too windy to set up the telescope outside. In addition the high albedo environment reduced the contrast making it quite difficult to see the fainter pores.

There were a few meteorological phenomena to see, most frequently solar halos or parts of them, often accompanied by the upper or lower arcs of contact. Parhelia were less frequent, though once there was a bright one. On a few occasions there was a sun pillar when the sun was low in the sky. Mirages were rare, but once we observed structures at the old site through the telescope. This location is some 30km away but appeared raised up above the true horizon. As it was summer the temperature never got really cold, and on a calm day you could go out in a t-shirt. As February arrived the shadows began to lengthen and it got colder, with -21 deg C recorded overnight on one occasion. We are due to depart soon, and as I write the Sun will set for the first time in several months. Summer here has ended, but spring is arriving in Cambridge and with it the opportunity to observe in more familiar skies.



Jonathan Shanklin
Halley Research Station, Antarctica

Opposite: The new spectrophotometer

Left: A parhelion or Sun dog

ASTRONOMY: A PERSONAL MEMOIR

In an excerpt from his memoirs about the development of his interest in astronomy as a child and student, a former Chairman shares the stories of how he became involved in CUAS

At the end of September 1965 I went up to Cambridge after 8 months working in the research labs of Monsanto Chemical in the period between Cambridge entrance exams and starting at university. (I earned over 10 pounds a week doing this!). Cambridge showed me a whole new side to astronomy. I was aware before going up that there was a very active astronomical society there and quickly discovered that members had access to a Victorian refracting telescope with a 12-inch diameter lens in a substantial, if old-fashioned, observatory. I became a regular there and remember often having to seek permission from my tutor to stay out late at night as the rule was that everyone was in their college rooms by 10 pm. There were many members with amateur interests like mine, but also those with ambitions to be professional astronomers. These usually were studying pure mathematics – which did not interest me – and were often somewhat dismissive of what could be done merely looking through a telescope. So it was not difficult to decide that astronomy was not a professional ambition. It had never been. How I came to look in the opposite direction, that is into the earth as it were, is another story.

Apart from doing things at the Observatories, CUAS, the astronomical society held meetings most Wednesday evenings when astronomers from the university and from all over the country came to give public lectures. Attendance was always high and the opening lecture of the year was designed to attract new members for the season and probably attracted several hundred into the audience. In these terms, we reckoned CUAS was the largest scientific society in the university, The chairman of the society also, by tradition, hosted a coffee morning of the CUAS die-hards in his room every Sunday morning. The Mill Lane lecture rooms were the usual venue.

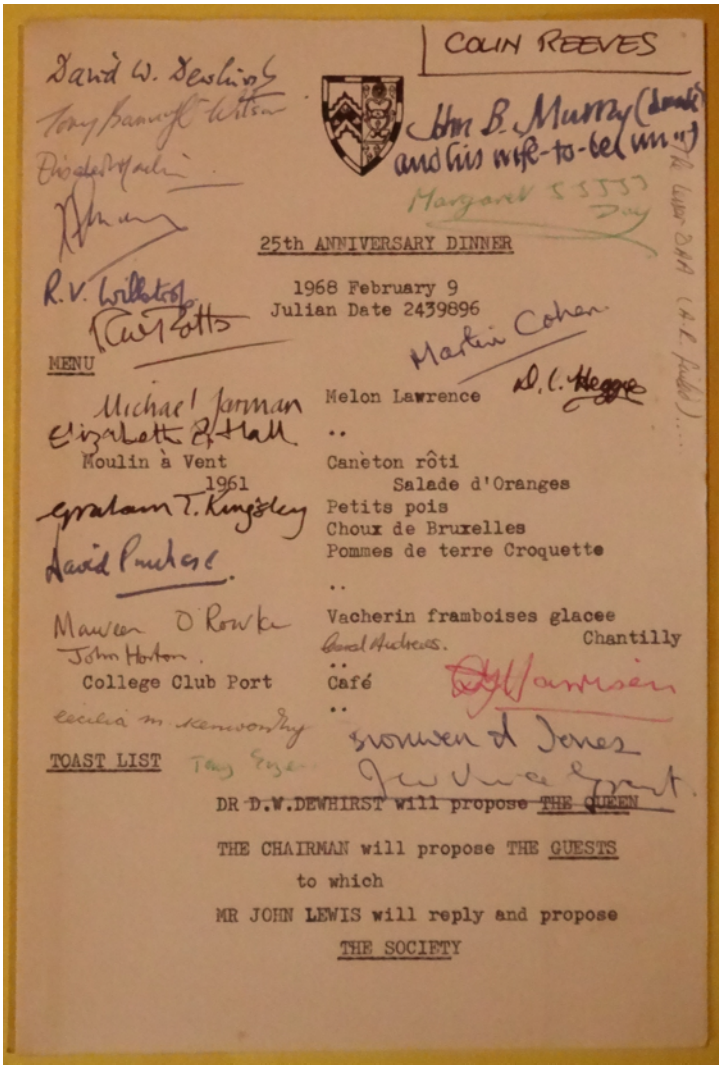
I probably put more of my 'spare' time into CUAS than was sensible as the Cambridge terms were short and full of work things to do, including a full programme of course lectures in which Saturday mornings were just as busy as Monday to Friday. But it was my main social outlet and I soon found

myself on the committee. The chairman in my second year was David Allen who went on to get a PhD in astronomy and become director of the Anglo-Australian telescope in western New South Wales. (He died tragically young before we went to Australia).

When the time came for him to step down, at Easter 1967, he insisted that I became his successor as chairman. My year, 1967-8, included CUAS's 25th anniversary, celebrated with a dinner in Caius with several old-timers showing up. Before that there was a whole programme of Wednesday evening lecturers for me to set up. Most of those invited were flattered and agreed willingly. Many have since had particularly distinguished careers in science. My big-name opening speaker was Prof Sir Martin Ryle who went on to become Astronomer Royal and share the Nobel Prize with Anthony Hewish - a fellow of Caius – for their work in radio astronomy. My first ever attempt at making a poster was for that meeting. I still have a copy and note with some pleasure from the internet that the CUAS logo I designed as part of it went on being used by the Society well into the 1980s.

In September 1969 I moved on from Cambridge to Birmingham university to study applied geophysics, on the recommendation of some Cambridge geophysicists who wisely thought that practical rather than theoretical activities would be more suited to my talents. There was an astronomical society there too, but after a couple of rather half-hearted meetings I Decided that I had had my fill of such activities, after the lord-mayor's show, as it were.

Colin Reeves (Chairman 1967-68)


COLIN REEVES

25th ANNIVERSARY DINNER

1968 February 9
Julian Date 2439896

MENU

Melon Lawrence
..
Canèton rôti
Salade d'Oranges
Petits pois
Choux de Bruxelles
Pommes de terre Croquette
..
Vacherin framboises glacee
Chantilly
..
Café
..

Moulin à Vent
1961
College Club Port

TOAST LIST

DR D.W.DEWHIRST will propose THE QUEEN

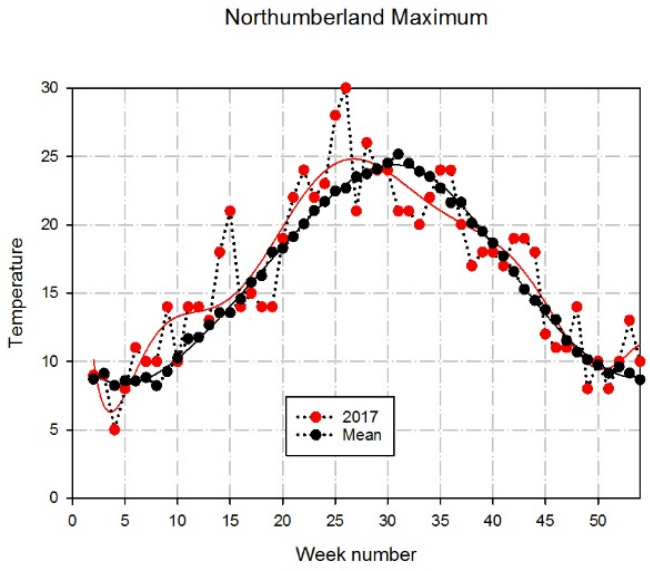
THE CHAIRMAN will propose THE GUESTS
to which
MR JOHN LEWIS will reply and propose
THE SOCIETY

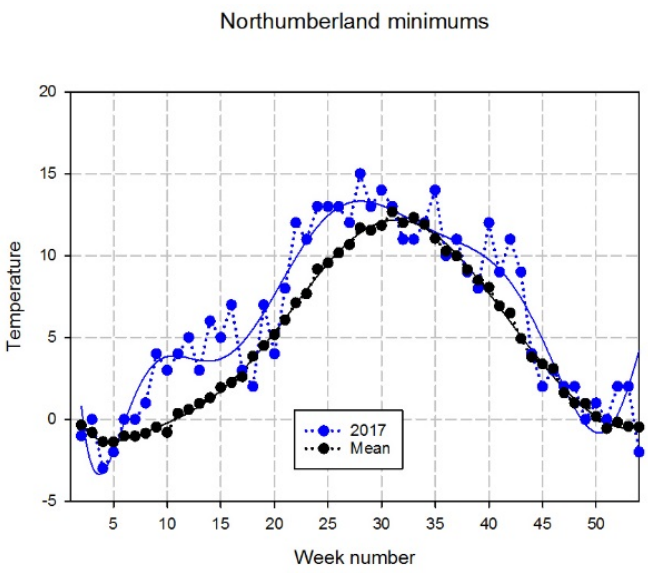
Pictured: A signed menu card from the 25th anniversary dinner in 1968

NORTHUMBERLAND TEMPERATURES

Since 1978 I have been recording the weekly maximum and minimum temperatures by the Northumberland dome. Although I am not always in Cambridge every week to take the readings (and sometimes not there for several months at a time), the British Antarctic Survey has an automatic weather station (AWS) that allows filling in of the gaps. There is an offset in temperature between the two locations because the AWS is in a more open area and so records lower minima and higher maxima. This offset has been applied where necessary.

2017 was a fairly average year. The minimum was generally a little above the long term mean, whilst the maximum was close to it, albeit with a couple of weeks with warm temperatures.





The coldest temperature recorded during the 40 year period was -13 in January 1982. I was in the Antarctic at the time, but I do recall carrying out a watch for Geminid meteors in December 1981 when the temperature was -10. The warmest was +33 in August 1990, though +32 in July 2015 came close.

Over the forty year period there hasn't been much change in the annual mean maximum temperature, however the minimum shows a clear increase of about three degrees. In part this change in the minimum is likely to be due to the change in the environment of the Observatories. When the sequence started there was more open ground around the Northumberland dome, and there were few high power computer systems requiring

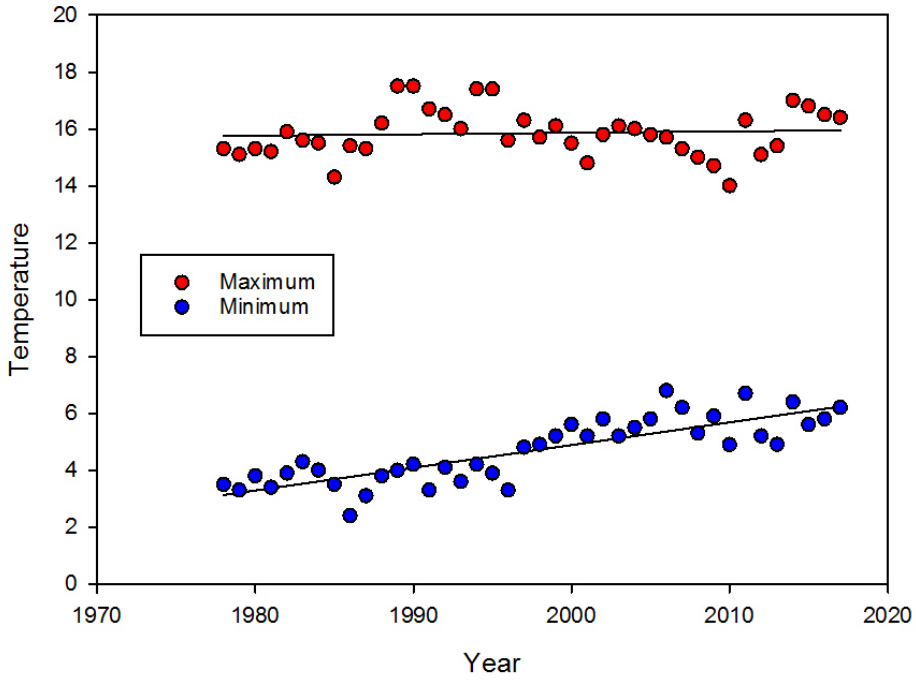
air-conditioning. In part it is also climate change showing its hand. The trend in minimum temperature is comparable to that seen in the region as a whole (see http://www.ukcip.org.uk/wp-content/PDFs/UKCP09_Trends.pdf). Regionally there is a similar trend in the maximum temperature, but for the Observatories this could be being ameliorated by the thermal mass of the adjacent building.

The annual mean temperature curves show that the summer half of the year (i.e. when the temperature is above half the amplitude of the annual cycle) is shorter than the winter half, with roughly 22 weeks of summer compared to 30 weeks of winter. Splitting the data into these two halves, shows that there has been a slight summer cooling in the maximum temperature, with an equal winter warming. The warming of the minimum temperature is slightly greater in the winter half of the year than it is in the summer.

As idle speculation [with no scientific basis], if the trend was extended back to 1942, the birth year of CUAS, it indicates an average winter minimum of -3.8, and when the Northumberland was installed in 1838 it could have been -12.8. This could provide Challis with another excuse for not discovering Neptune – it was just too cold!

Jonathan Shanklin

Northumberland Dome annual mean temperature



TALK POSTERS

Check out the amazing posters made by Li Xin to advertise our talks each week: