Light Pollution and its Impact

The Ninth European Symposium

for the Protection of the Night Sky

Dublin and Armagh, 2009 September 16–19

Sky glow over Dublin contrasted with a view of Jupiter and the Milky Way taken from a dark-sky site at Mount Parnon, Greece. Images courtesy Albert White and Frank Ryan Jnr.

Acknowledgements

The inspiration for this meeting arose several years ago when two of us (Mark Bailey [Armagh Observatory] and Albert White [Irish Light Pollution Awareness Campaign]) attended the very well organized Sixth European Symposium for the Protection of the Night Sky, held in Portsmouth, England, from 15–16 September 2006. We are very grateful for the support of the organizers of that meeting in the present arrangements, and for the provision of leaflets and other material supplied courtesy of the British Astronomical Association Campaign for Dark Skies (CfDS).

We also thank the core institutional supporters of the meeting: the Republic of Ireland's Discover Science and Engineering programme; the Armagh Observatory and its core funding agency the Northern Ireland Department of Culture, Arts and Leisure (DCAL); the Royal Irish Academy (RIA), Dublin; and the Armagh and City District Council (ACDC). The important stimulus to astronomy education and public outreach activities provided by the United Nations International Year of Astronomy (IYA 2009), particularly in the UK and Ireland, must also be acknowledged and recognized, and we particularly thank Mike Redfern, Robert Hill and Miruna Popescu (the all-Ireland IYA 2009 – Ireland Secretariat) for their support and encouragement in the arrangements for this meeting from its earliest days. Robert Hill (Northern Ireland Space Office, Armagh Planetarium) has played a sterling role in practical arrangements for the meeting, particularly on the educational side.

Finally, we thank the International Dark-Sky Association (IDA) and IDA Europe in particular for their support; members of the Dark-Sky Discovery Project; all members of the Local Organizing Committee (reflecting organizations such as the Irish Federation of Astronomical Societies [IFAS], Astronomy Ireland [AI], the Irish Astronomical Association [IAA] and the Northern Ireland Amateur Astronomy Society [NIAAS]); the Armagh Planetarium; and — last but not least — the many speakers and participants at the meeting who have helped to put Light Pollution and what to do about it on the public agenda, not just locally but throughout these islands and farther afield.

Albert White (ILPAC)
Terry Moseley (IAA)
Mark Bailey (Armagh Observatory)

2009 September 9

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

The Market Place Theatre, Armagh

Thursday 17th to Saturday 19th September 2009

Public Lecture: Wednesday 16th September
18:30 for 19:00, Royal Irish Academy, Dublin

18:30	**Arrival at Royal Irish Academy, 19 Dawson Street, Dublin 2**
19:00–19:20	**Welcome and Opening Remarks** *Representatives of RIA; Irish Government; Conference Organizing Committee*
19:20–20:00	**What is Light?** *Leo Enright (Journalist and Science Broadcaster)*
20:00–20:15	**Question and Answer Session** *Chaired by Mark Bailey*
20:15–21:00	**Discussion and Light Refreshments**

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

The Market Place Theatre, Armagh

Thursday 17th to Saturday 19th September 2009

Pre-Conference Social Events: Thursday 17th September

13:30–14:45 **Mayoral Reception (Armagh City and District Council)**
The Mayor of Armagh City and District, Councillor Thomas O'Hanlon, will host a lunchtime reception for conference participants in the Mayor's Parlour, The Palace Demesne. **Those able to attend should contact Mark Bailey (meb@arm.ac.uk)**. *Numbers limited.*

15:00–16:30 **Easy Going Guided Walk of Armagh City**
Led by Barbara Ferguson (Armagh Guided Tours; see http://www.armaghguidedtours.com/). Those interested should meet at the Armagh Tourist Information Centre at 15:00. The tour will take about 1.5 hours and cost £5.00 per person. No need to book.

Public Lecture: Thursday 17th September
19:00 for 19:30, Market Place Theatre, Armagh

17:00–19:30 **Registration at The Market Place Theatre, Armagh**

19:30–19:40 **Welcome and Opening Remarks**
Mark Bailey (Conference Organizing Committee) and Others

19:40–20:20 **What is Light?**
Leo Enright (Journalist and Science Broadcaster)

20:20–20:30 **Question and Answer Session**
Chaired by Mark Bailey

20:30–21:30 **Discussion and Light Refreshments**

21:30–23:00 **Salsa Dance Workshop in the Market Place Stage Bar**
Miruna Popescu (Armagh Observatory) will provide light entertainment in a dark room for all those who want to learn a few steps of Latin-American dance in a relaxing atmosphere . . . Late Bar.

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

Friday 18th September (Morning)

08:45–12:00 **Registration at The Market Place Theatre, Armagh**

09:00 **Morning Coffee**

09:30–11:30 — Welcome Session

09:30–09:50 **Welcome and Opening Remarks**
Mark Bailey (Conference Organizing Committee); Councillor Thomas O'Hanlon (Mayor, Armagh City and District); Jim Nicholson (MEP, Northern Ireland); Peter Brabazon (DSE, Ireland) "DSE Programmes and the Smart Economy"; Mick Cory (Department of Culture, Arts and Leisure)

09:50–10:35 **Light Pollution: An Overview**
John Mason (South Downs Planetarium, Chichester)

10:35–11:05 **Frequently Asked Questions**
Bob Mizon (Campaign for Dark Skies)

11:05–11:30 **The International Dark-Sky Association: 21 Years of Night-Sky Protection**
Kim Patten (Programs Director and Public Affairs, International Dark-Sky Association)

11:30–11:50 **COFFEE** *Parallel Primary School Education Session: "The Dragon's Egg — Story-Telling and Astro-Art Fun Workshop", with Anne Hart, Brenda Campbell and Breige Delaney (Mount St. Catherine's School, Armagh), Miruna Popescu (Armagh Observatory) and Dara Vallely, Peter Shortall and Steve Lally (Armagh Rhymers)*

11:50–13:30 — Policy Session

11:50–12:30 **Intelligent Streetlighting**
Sean Noone (Chairman and Managing Director, Superior Electronic Lighting Controllers [SELC] Ireland Ltd.)

12:30–12:50 **Light Pollution in the Netherlands: Inventories and Movements in Dutch Policy**
Dorien Lolkema (National Institute for Public Health and the Environment, The Netherlands)

12:50–13:10 **LED Street Lighting and Light Pollution: New Political and Administrative Actions in Germany**
Andreas Hänel (Osnabrück Planetarium)

13:10–13:30 **Critically Appraising the Alleged Benefits of Lighting on Public Safety: New Results**
Paul Marchant (Leeds Metropolitan University)

13:30–14:30 **LUNCH** — And Conference Photograph (Weather Permitting)

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

Friday 18th September (Afternoon)

14:30–16:30 — Environment and Astronomy Session

14:30–15:00 **Shedding Light on Bat Behaviour — How Street Lights Disturb Commuting Bats**
Emma Stone (University of Bristol)

15:00–15:30 **The Turtle's Tale — Environmental Impacts of Light Pollution**
Sue Christie (Northern Ireland Environment Link, Belfast)

15:30–15:50 **The Environmental, Social and Medical Implications of Light Pollution**
Graham Cliff (University of Manchester)

15:50–16:10 **Globe at Night: An International Citizen-Science Program to Measure Night-Sky Brightness. Involvement, Outcomes and Sustainability**
Dr Constance E. Walker (U.S. National Optical Astronomy Observatory)

16:10–16:30 **Astronomical Research with Small Telescopes in an Urban Environment**
Simon Jeffery (Armagh Observatory)

16:30–17:00 TEA

17:00–17:45 — Health Session (Plenary)

17:00–17:30 Plenary Session

17:00–17:20 **Light Pollution and Sleep (Video)**
Steven Lockley (Harvard Medical School)

17:20–17:30 **Report from Dark-Sky Camp in Lastovo Island, Croatia (Video)**
Andrej Mohar (Dark Sky Slovenia)

17:30–17:45 Plenary Discussion and Closing Remarks

17:45–24:00 Evening Tour to Dark-Sky Site at Beaghmore Stone Circles and Buffet Meal at An Creagán Visitor Centre, Co. Tyrone (Free to Registered Participants)
The coach (Orchard County Travel) must and will depart promptly at 18:00 from beside St. Patrick's Church of Ireland Cathedral at the top of the hill close to the historic Armagh Public Library. We will arrive in time to witness sunset at Beaghmore (see http://en.wikipedia.org/wiki/Beaghmore), c.19:30, and will then have time to enjoy the displays and a buffet meal at An Creagán Visitor Centre (see http://www.ancreagan.com/), from c.20:15 to 21:30. Weather permitting, we return to Beaghmore for dark-sky observing until 23:00 and the coach will return to Armagh around midnight. Otherwise we will return around 22:30. Bring warm clothes.

19:30–21:00 Alternative Choice: A Free Visit to the Armagh Planetarium
Presentation and guided tour by Tom Mason, followed by Planetarium Show.

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

Saturday 19th September (Morning)

09:20–09:30 **Welcome Back**
Albert White (Organizing Committee)

09:30–11:30 — IDA and Dark-Sky Projects Session

09:30–09:40 **Borrego Springs, California — A Dark Sky Community**
James Hoban Rickard (Astronomer, and Member of the Borrego Springs Dark Sky Committee)

09:40–10:10 **Dark Sky Discovery Project**
Dan Hillier (Royal Observatory Edinburgh, UK Science and Technology Facilities Council, Scotland)

10:10–10:30 **International Dark Sky Park Certification**
Kim Patten (Programs Director and Public Affairs, International Dark-Sky Association)

10:30–11:30 **International Cooperation ("IDA Town Hall Meeting")**
Bob Parks (Managing Director, IDA Washington DC Office of Public Policy and Government Affairs) and Friedel Pas (IDA Europe, IDA Board Member)
Bob Parks will lead an open forum discussion on the future of the IDA and how the IDA can become more international in scope, exploring new ways to enhance cooperation with light-pollution reform groups around the globe. Friedel Pas will also provide an update on IDA activities in Europe. All attendees are encouraged to bring fresh ideas for how organizations and countries throughout the world can work together to reduce light pollution.

11:30–12:00 COFFEE

12:00–13:00 — Education Session

12:00–12:20 **Light Pollution and Possibilities for Curriculum Inclusion**
Robert Hill (Northern Ireland Space Office, Armagh Planetarium, Armagh)

12:20–12:40 **How Many Stars Can We Still See? 2001–2009**
Günther Wuchterl (Thüringer Landessternwarte Tautenburg, Germany)

12:40–13:00 **An Example of Energy and Environmental Education through Light Pollution in High-School Classes in Japan**
Nobuaki Ochi (Yonago National College of Technology, Japan)

13:00–14:00 LUNCH

LIGHT POLLUTION AND ITS IMPACT

"The Ninth European Symposium for the Protection of the Night Sky"

Saturday 19th September (Early Afternoon)

14:00–16:00 — Technical Parallel Session (Held in Studio Theatre)

14:00–14:20 **Small-Aperture Astronomy in the Modern Era: A Personal Account**
Apostolos Christou (Armagh Observatory)

14:20–14:40 **Looking for Dark Observing Places: Satellite Data and Sky Quality Meter (SQM) Measurements**
Andreas Hänel (Osnabrück Planetarium)

14:40–15:00 **Dark Sky Monitoring in Hungary**
Zoltán Kolláth (Konkoly Observatory, Budapest, Hungary)

15:00–15:20 **Results and Measurements from 4 Years of Light-Pollution Measurements in Holland**
Wim Schmidt (Platform Lichthinder, Nederland)

15:20–15:40 **Monitoring Night-Sky Brightness with a Lightmeter Network**
Günther Wuchterl (Thüringer Landessternwarte Tautenburg, Germany)

15:40–16:00 **A Simple Scale to Determine the Level of Light Pollution**
Tomas Graf (The Observatory and Planetarium of Johann Palisa, VSB-TU, Ostrava, Czech Republic)

14:00–16:00 — Education Parallel Session (Held in Workshop 1)

14:00–16:00 **The 'Light Pollution Challenge' Pilot: A 3-D Education Gaming Project**
Organized by Robert Hill with additional support from the North Eastern Education Library Board (NEELB)

- *Students from NI Years 8 and 9 and RoI Transition Year. Involved schools:*
  - ☺ *Antrim Grammar School, Co. Antrim*
  - ☺ *St. Patrick's College, Maghera, Co. Derry*
  - ☺ *St. MacNissi's College, Garron Tower, Co. Antrim*
  - ☺ *Belvedere College, S.J., Dublin*
  - ☺ *St. Dominic's High School, Santa Sabina, Dublin*
  - ☺ *De La Salle College, Churchtown, Dublin*
  - ☺ *Gonzaga College, S.J., Dublin*

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Saturday 19th September (Late Afternoon)

16:00–16:30 **TEA**

16:30–18:00 — Final Plenary Session

16:30–18:00 **Plenary Session**

16:30–16:50 **The Dark Skies Awareness Programs for the International Year of Astronomy: Involvement, Outcomes and Sustainability**
Dr Constance E. Walker (U.S. National Optical Astronomy Observatory)

16:50–17:00 **The IYA 2009 UK Dark Sky Parks Initiative**
Steve Owens (UK Coordinator for IYA 2009, Glasgow Science Centre, Scotland)

17:00–17:15 **Report Back to Plenary Session from the "Light Pollution Challenge" Parallel Education Session**
Robert Hill (Northern Ireland Space Office, Armagh Planetarium, Armagh)

17:15–17:35 **International Dark-Sky Association Awards**
Kim Patten (Programs Director and Public Affairs, International Dark-Sky Association [IDA]) and Friedel Pas (IDA Europe, IDA Board Member)

17:35–17:40 **Next Year**
Zoltán Kolláth (Konkoly Observatory, Budapest, Hungary)

17:40–17:45 **Thanks and Closing Remarks**
Albert White (Irish Light Pollution Awareness Campaign)

18:30–20:00 **Public Lecture at Armagh Planetarium**
Dr Don Pollacco (Queen's University Belfast)
"Exoplanets — The Hunt for the Earth Analogue"
Don Pollacco is Project Scientist and originator of the WASP project (Wide Angle Search for Planets).

20:30–23:30 **Conference Dinner, Armagh City Hotel**

Invited and Contributed Talks

1. **What is Light?**
   Leo Enright

   Leo Enright, a broadcaster on Space Exploration and Science, explores the history of Ireland's sometimes tenuous connection with luminosity — while naming and shaming some modern big wicks. He will focus on the importance of continuing public access to dark skies, especially during the present 'Golden Age' of astronomy, whilst noting that historically Ireland has sometimes been defined by the absence of light — as why else would the Romans have called it Hibernia?

2. **Light Pollution: An Overview**
   John Mason (South Downs Planetarium, Chichester)

   An Introduction to light pollution: its effects, what we can do about it; and why we really need to do something about it!

3. **Light Pollution FAQs**
   Bob Mizon (Coordinator, Campaign for Dark Skies)

   This contribution will discuss the ten most frequently asked questions from correspondents to the BAA Campaign for Dark Skies, covering skyglow causes and remedies, crime, the legal aspect of intrusive light, health issues etc.

4. **The International Dark-Sky Association: 21 Years of Night-Sky Protection**
   Kim Patten (Programs Director, International Dark-Sky Association)

   The November 2008 edition of National Geographic asked the question "The End of Night?" on its cover. This cover was then translated into dozens of languages and distributed throughout the world, while the article divulged the continuing degradation of the night as the world becomes more urbanized and modernized. The article also described the steps that communities and organizations were doing to ensure that this statement does not become reality. We at the International Dark-Sky Association certainly hope that the answer to the question is "NO!". 2008 marked the pivotal 20-year anniversary for the International Dark-Sky Association. As we move from being a so-called fringe organization with extremist thoughts into the mainstream it's necessary to maintain focused on the end goal; preservation and restoration of a natural night environment that is safe for all walks of life. Over the past twenty years we have done much to educate and promote the usage of environmentally friendly outdoor lighting for the preservation of ground-based astronomy, ecologically sensitive regions, energy efficiency, and general nighttime ambiance. In looking ahead to the next twenty years we look forward to not only continuing this education, but moving towards a global understanding of the preservation and restoration of night skies. With a worldwide push for energy efficiency, now is the time to encourage retrofitting of outdated lighting installations. More and more lighting retrofits, from Canada to Slovenia, are showing improvements in nighttime visibility both on the street and of the heavens. The free educational materials and activities available from the IDA, along with advice from activists across the globe help enable and ensure that proper planning for the protection of the night can advance well into the future. It is our intention that within the next twenty years, National Geographic and other publications worldwide are proudly proclaiming "Seeing the Dark".

5. **Intelligent Streetlighting**
Sean Noone (Chairman and Managing Director, Superior Electronic Lighting Controllers [SELC] Ireland Ltd.)

The presentation reviews the SELC Candelon streetlight monitoring and control system. Streetlights provide peace of mind and safety at night, enhanced vision when driving, security against vandalism and personal attack, and an invitation to do business and socialise at night in our towns and cities. However, they are costly to maintain and operate. They also consume large amounts of precious energy and manpower in producing and installing spare parts, routine maintenance, identifying faults and dealing with citizen's complaints. Street lights can consume up to 40% of a city's electrical energy, with a cost of the order of £1M per 100,000 people every year and a correspondingly large carbon footprint. The talk will show how the specialist control system and the pioneering dimming system for streetlighting developed by SELC can provide significant energy savings and reduction of light pollution.

6. **Light Pollution in the Netherlands: Inventories and Movements in Dutch Policy**
Dorien Lolkema and D.P.J. Swart (National Institute for Public Health and the Environment, The Netherlands)

The Netherlands is one of the brightest night-time areas on Earth. This year (2009), national policy on light pollution and protection of the night sky will be formulated. Meanwhile, local government is taking its stand in this political arena on night-time lighting. Diverse inventories are and have been carried out concerning night-time light emission. This presentation will give an overview of these inventories and on movements in Dutch policy concerning light pollution.

7. **LED Street Lighting and Light Pollution: New Political and Administrative Actions in Germany**
Andreas Hänel (Osnabrück Planetarium)

LED street lighting is developing very fast, although we do not yet fully understand the technique and its ecological impact. Studies of new test installations in some German cities (Düsseldorf, Hannover, Stuttgart, Westerkappeln) and some first experiences are reported. Meanwhile, politics and administrative structures in Germany are beginning to recognize the problem of light pollution; here we report on some new developments.

8. **Critically Appraising the Alleged Benefits of Lighting on Public Safety: New Results**
Paul Marchant (Leeds Metropolitan University)

Much is made of the benefits of lighting for public safety. Lighting is claimed to substantially reduce crime and also road traffic accidents. But are the claims true? I have previously criticised work, which purports to show substantial benefits, for lack of scientific and statistical rigour; for example in the British Journal of Criminology (See www.britastro.org/darkskies/cfds2006/proceedings.pdf and www.radstats.org.uk/no091/Marchant91.pdf). This presentation will update previous work in this field with more recent studies and will show why the lavish claims which are made are still suspect. Furthermore, results from the analysis of other data will be presented. Scientific scepticism remains warranted concerning the alleged public safety benefits of lighting.

9. **Shedding Light on Bat Behaviour — How Street Lights Disturb Commuting Bats**
Emma Stone, S. Harris and G. Jones (University of Bristol)

Artificial lighting schemes can damage bat foraging habitat directly, through loss of land and fragmentation, or indirectly by severing commuting routes from roosts, polluting watercourses and foraging habitat. The impact of street lighting on bat activity was tested using experiments along lesser horseshoe bat commuting routes at eight sites across Wales and South West England. Hedgerows were illuminated at a mean of 53 lux using two portable high-pressure sodium street lights. Bat activity was recorded using AnaBat remote acoustic detectors. Repeated-measures analysis of variance (ANOVA) was used to test the effect of experimental treatment on bat activity. Treatment type had a significant effect on bat activity ($p \leq 0.01$). Contrasts demonstrated that all light treatments were significantly different from controls ($p \leq 0.05$), demonstrating that high-pressure sodium light has a negative effect on lesser horseshoe bat activity. This study has provided the first empirical evidence of a negative effect of high-pressure sodium lights on commuting horseshoe bats and has significant conservation implications for bat habitat management at sites affected by light pollution. Results from this study will be used to develop evidence based mitigation guidance for bats and lighting in the UK.

10. **The Turtle's Tale — Environmental Impacts of Light Pollution**
Sue Christie (Northern Ireland Environment Link, Belfast)

Light is used by many animals and plants as a key cue for carrying out important activities such as flowering, migrating or feeding. As artificial light becomes a more prominent feature of their environment, evidence is accumulating of the negative impacts it has on wildlife. Baby turtles hatching on resort beaches head towards the lit-up resort rather than out to sea — and are eaten by predators before they can correct the error. Migrating birds are disoriented, and at worst fly into the ground or buildings as they try to identify the Moon and stars among a multitude of man-made light sources. Moths fly into street lights rather than feed; breeding cycles of butterflies are disrupted; nocturnal animals are gobbled up by predators instead of being hidden in the darkness. Artificial light disturbs the rhythms of insects and birds, leading to far-reaching consequences in ecosystems throughout the world. Constant light disrupts hormones and hence breeding patterns of frogs and other animals. Nocturnal hunters may benefit by increased light levels, but their prey certainly do not; many animals will not emerge to feed if light levels are too high. Plants too are affected by light — timings of flowering and leaf fall in many species is governed by day length and light levels, germination can be affected by light and the efficiency of photosynthesis can be damaged without true darkness. Algal blooms exacerbated by excess light cause deaths of fish and invertebrates in ponds and lakes. On top of that, some one third of lighting is 'wasted' with consequent impacts on climate change and costs, estimated at $2 billion per year in the USA alone. There is an easy solution to all of this — reduce the amount of artificial lighting, especially in the countryside; ensure that the necessary light is produced and used efficiently; restrict lighting to when and where it is actually required by people; and ensure that light is directed only to where it is needed.

11. **The Environmental, Social and Medical Implications of Light Pollution**
Graham Cliff (University of Manchester) and Colin Henshaw (Tabuk, Saudi Arabia)

Light pollution as a problem has been intensifying over the past forty or fifty years, but only now have the consequences of the problem become to be appreciated. It is a serious problem that requires urgent resolution, and this paper serves to highlight that problem, emphasize its effects and look towards a solution.

12. **Globe at Night: An International Citizen-Science Program to Measure Night-Sky Brightness. Involvement, Outcomes and Sustainability**
Dr Constance E. Walker (U.S. National Optical Astronomy Observatory [NOAO]), Steve Pompea (NOAO), David Smith (UCAR), Tom Baker (ESRI), David Orellana (CTIO), Hugo Ochoa (CTIO) and Kim Patten (IDA)

GLOBE at Night is an international citizen-science event encouraging everyone to measure local levels of light pollution and contribute the observations online to a world map. This program is a centerpiece of the Dark Skies Awareness Global Cornerstone Project for the International Year of Astronomy. Its goal is to raise public awareness of the impact of artificial lighting on local environments by getting people involved. Data collection and online reporting is simple and user-friendly. During a 2-week campaign in each spring, citizen-scientists take data on light pollution levels by comparing observations with stellar maps of limiting magnitudes toward the constellation, Orion. For more precise measurements, citizen-scientists use digital sky brightness meters. During the campaign period over the last 4 years, 35,000 measurements from 100 countries have been logged. The collected data is available online in a variety of formats and for comparison with data from previous years. We will discuss how the data has been used, provide information to become community advocates, and mention future plans for analysis with other data sets. We will also discuss lessons learned, best practices and plans during the next campaign. For more information, visit http://www.globe.gov/GaN/.

13. **Astronomical Research with Small Telescopes in an Urban Environment**
Simon Jeffery (Armagh Observatory)

Increasing human activity associated with night-time illumination has an obvious impact on the visibility of the night sky. For the most demanding astronomical goals, the only solution is to observe from remote and protected locations, or from space. There remain many science goals that can be pursued with small to medium telescopes; the use of modern CCD cameras makes these many times more efficient than their counterparts of 25 years ago. The challenge is to make best use of available starlight and weather windows, using a variety of automation techniques. (i) The Armagh Observatory Polar Bear Survey Telescope (PBST) was constructed in 2009 to (a) study variability amongst some 10,000 stars at the North Celestial Pole and (b) to provide a baseline measurement of the night-sky brightness from which to measure future changes in light pollution over Armagh. (ii) The Armagh Observatory Robotic Telescope will be commissioned in 2009/2010 to allow follow-up observations of variable star discoveries, exoplanet timings, solar-system events. This talk will describe the rationale and designs for these telescopes, and show some early data from the PBST.

14. **Light Pollution and Sleep (Video)**
Steven Lockley (Harvard Medical School)

Humans, like many other species, have evolved in the presence of the daily light-dark cycle generated by the Earth's rotation about its axis. This 24-hour light-dark signal has provided a powerful evolutionary pressure for adaptation to particular temporal niches, for example, adaptation to being day-active (diurnal) or night-active (nocturnal). It is only relatively recently that humans have developed the capacity to generate light. In the last 120 years, however, access and exposure to artificial light at night have become pervasive in all industrialised nations and are becoming increasingly so in the developing world. This light affects all organisms exposed to it, not just humans, and the consequences of such a dramatic alteration in one of the most powerful environmental signals is not yet known. Given its relatively recent introduction, we are only at the beginning of understanding the impact of artificial light on human health. Research over the past 80 years, however, has shown that light exerts very powerful effects on human physiology, endocrinology and behaviour, and, having evolved in a distinct light-dark cycle, it is likely possible that unnatural exposure to artificial light at night is hazardous to human health. This presentation will review the effects of light on human biology and how these effects should be considered for ensuring a healthy light and dark environment.

15. **Report from Dark-Sky Camp in Lastovo Island, Croatia (Video)**
Andrej Mohar (Dark Sky Slovenia)

Lastovo Island is perhaps the darkest spot in Europe, and with the Sun currently within a deep minimum of solar activity the starry sky as seen from Lastovo will be even more brilliant. We plan to reconstruct the lighting at Lastovo to conform with the Slovene light-pollution law. In Slovene municipalities such laws have already reduced energy consumption by amounts up to 60%, and at Zaplana Observatory, just 22 km from Ljubljana, the night sky is already 10% darker — just two years after the adoption of the Slovene light-pollution law.

16. **Borrego Springs, California — A Dark Sky Community**
James Hoban Rickard (Astronomer, and Member of the Borrego Springs Dark Sky Committee)

On 2009 July 31 the International Dark Sky Association selected the town of Borrego Springs, California, as a Dark Sky Community, a designation not easily obtained. The only other community so designated is Flagstaff, Arizona, the home of Lowell Observatory and a US Naval Observatory telescope. James sat on the committee during the two-year application process. Since he regularly provides free star-gazing programmes for visitors to the desert community of 4,000, he is keen that the village maintain its dark skies. The designation shows that the town meets the minimum criteria, and also provides impetus for local businesses and homeowners to use only appropriate lighting in the future. The talk will describe how towns can benefit by the establishment of lighting criteria by concerned local groups.

17. **Dark Sky Discovery Project**
Dan Hillier (Royal Observatory Edinburgh, UK Science and Technology Facilities Council, Scotland)

The Dark Sky Discovery Project is seeking to support good practice in astronomy communication and education throughout the UK and Ireland. It is harnessing the inspirational appeal of "Dark Skies" to create new opportunities in this field. It has its roots in the very successful Dark Sky Scotland partnership which was launched by the Deputy First Minister for Scotland in 2007. That partnership has brought new partners, funding and PR to public and school astronomy in Scotland, creating a Dark Sky Team of skilled scientists, science communicators and amateur astronomers to deliver events for audiences in both rural and urban communities. At the heart of its approach are training workshops for teachers, other educators and group leaders to help build their capacity for running activities themselves. Dark Sky Scotland has been particularly successful in working with environmental and outdoor learning organizations. The Dark Sky Discovery project is inviting organizations in other parts of the UK and Ireland to form similar partnerships that build on their own expertise and experience to plan and deliver similar activities in their own area. Some 30 organizations are already involved and the project is raising funds to support a two year programme of activities. www.darkskydiscovery.org.uk.

18. **International Dark Sky Park Certification**
Kim Patten (Programs Director and Public Affairs, International Dark-Sky Association)

IDA takes great pride in its efforts to protect our nightscape. We also take pride in recognizing others who do the same. Through our International Dark Sky Places program, IDA and its partners certify locations with exceptional nightscapes as International Dark Sky Communities (IDSC), International Dark Sky Parks (IDSP), and International Dark Sky Reserves (IDSR). These locations serve as reminders that with quality outdoor lighting, the extraordinary wonders of the night-time sky and night environment are just as much a part of our lifestyle and history as are the daylight hours. In fact, without the inspiration and wonders of the night-time environment much of the world's history, art, culture, music, and literature would not have been created. Simple steps in the planning process can ensure a prolonged commitment to the preservation of this natural resource. The IDS Places program includes these methods in order to provide a down-to-Earth yet substantial mechanism for the protection of the night sky.

19. **International Cooperation ("IDA Town Hall Meeting")**
Bob Parks (Managing Director, IDA Washington DC Office of Public Policy and Government Affairs) and Friedel Pas (IDA Europe, IDA Board Member)

IDA Board member Friedel Pas and Managing Director of the IDA DC Office of Public Policy and Government Affairs Bob Parks will lead an open forum to discuss the future of the International Dark-Sky Association (IDA). The discussion will focus on changes that are occurring at the IDA and explore how the IDA can become more international in scope. Attendees are encouraged to bring fresh ideas for how the world can work together to reduce light pollution. During this interactive session we will explore new ways to enhance cooperation with light pollution reform groups around the globe. We will try to identify ways to expand IDA membership, energize participation, and how better to support local sections and initiatives. Friedel Pas will also provide an update on IDA Europe activities and Bob Parks will talk about the creation of the new IDA office of Legislative Affairs and Public Policy in Washington, DC, and its initiatives.

20. **IDA Update in Europe**
Friedel Pas (International Dark-Sky Association)

The IDA faces a lot of challenges in Europe. The Energy-Using Products (EuP) directive is in progress and the European Standard EN-13201, referring to road lighting standards and performance requirements, is under review with additional parts. The IDA needs to be involved in that. In the past year the IDA has already done several things. Position statements concerning light and human health have been developed, and we participated in the important conferences, such as Starlight 2009. An overview of the most important issues and what these mean for light-pollution developments in Europe will be shown. The IDA is working on several model lighting codes. These are region specific, but it will be interesting to work one out for Europe too, based on the best lighting codes already existing in Europe. There will be time for discussion on this issue and on questions and suggestions for the working of the IDA in Europe.

21. **Light Pollution and Possibilities for Curriculum Inclusion**
Robert Hill (Northern Ireland Space Office, Armagh Planetarium, Armagh)

The topic of Light Pollution and the nature of the involved subject matters facilitates a multi-disciplinary approach to the topic within education systems. Many education authorities globally are either currently considering revisions to their respective curricula or creating task groups to discuss potential options for future educational outputs in line with the educational, skills and employment needs of their region. In Northern Ireland, the Northern Ireland Space Office has worked with the regional curriculum authority to align the learning potential offered by the topic of Light Pollution to the requirements of the revised Northern Ireland Curriculum. The resulting resources and support materials create a learning environment that encourages school children to recognize the importance of science, engineering and technology in modern industry and society, whilst gaining an understanding of the impact we can have on the world around us. This presentation will outline some of the holistic themes created for the Northern Ireland curriculum and highlight some possibilities for creative development in line with future skills and needs.

22. **How Many Stars Can We Still See? 2001–2009**
Günther Wuchterl, A. Chwatal, M. Reithofer (Thüringer Landessternwarte Tautenburg, Germany)

Visual sightings to estimate artificial sky brightening are well suited for citizen-science activities. We report on the results of eight years activities and focus on a direct comparison of two campaigns in May 2001 and 2009, with more than 2000 estimates in Austria.

23. **An Example of Energy and Environmental Education through Light Pollution in High-School Classes in Japan**
Nobuaki Ochi (Yonago National College of Technology, Japan)

In Japanese high school classes we have performed an energy and environmental education program through light pollution. First, in this program, facts on the global warming and the energy problem are lectured to students. After some questionnaires, fundamentals of the light pollution and the nocturnal condition of their city are shown by pictures and video clips, followed by discussion on effective use of energy. Details and the educational effect of the program will be presented at the symposium. We will also show a nocturnal outdoor illuminance map measured by high school students using lux meters.

24. **Small-Aperture Astronomy in the Modern Era: A Personal Account**
Apostolos Christou (Armagh Observatory)

During the past decade, the advent of good-quality commercially available CCD and video equipment has opened up astronomical niches where aperture is no longer the main driver for science-grade measurements. Parallel advances in technologies such as GPS, the Internet, data processing and robotisation have rendered serious astronomical observation much more accessible to the amateur and professional alike. In this presentation, I will provide a historical account of my own experience with small-aperture instruments, mainly dealing with objects in our own solar system. Through these experiences and those of others in the astronomical profession, I will highlight the importance of careful target selection and adequate planning to ensure that the final result justifies the effort. Finally I will show how networks of amateur astronomers can make a real contribution to publication-grade astronomical research if ably directed and coordinated by experts.

25. **Looking for Dark Observing Places: Satellite Data and SQM Measurements**
Andreas Hänel (Osnabrück Planetarium)

How helpful are the DMSP satellite pictures and Cinzano's light pollution maps to find dark observing places in Europe? Since the last symposium, in Vienna, I have visited potentially dark observing places in nature parks in the Austrian Alps, the Eifel, Westhavelland and additional places in Southern France and Spain. Measurements with the SQM and a DSLR are compared with the light pollution maps. The feasibility of nature parks in densely populated regions will be discussed.

26. **Dark Sky Monitoring in Hungary**
Zoltán Kolláth (Konkoly Observatory, Budapest, Hungary), Zoltán Szegvári (Duna-Dráva National Park Directorate), István Gyarmathy (Hortobágy National Park Directorate), and András Pintér (Duna-Dráva National Park Directorate)

The Hungarian protected area network almost overlaps with the dark-sky areas. This fact indicates their mission in protecting dark skies, as nature conservation is deeply interrelated with protecting the nocturnal landscape. Our goal was to identify those areas which could be suitable for nomination to be dark-sky parks. Our primary targets are the Zselic Landscape Protection Area and the Hortobágy National Park. The Ministry of Environment and Water has approved the accentuated inclusion of dark-sky awareness in the management plans. Policy against light pollution will be included in the management plans of all the national parks and protected areas. As a consequence of our efforts, the new Hungarian 'Law for Protection of Nature' includes the possibility to control artificial lights in protected areas. A special monitoring program has been started to survey the quality of the night sky using Sky Quality Meters (SQM) and DSLR cameras in the protected areas. We developed a program package to calibrate and display luminance distributions in raw images taken by a DSLR camera. Images, taken by fish-eye lens at different locations, help to pinpoint polluting sources. The main conclusion of our measurements is that the local settlements have only a minimal effect on the quality of the sky. The luminance is only slightly increased in the vicinity of the small villages. There are light-domes due to the neighbouring cities only close to the horizon. We will nominate both protected areas for the 'Dark Sky Park program' of the International Dark-Sky Association during this year.

27. **Results and Measurements from 4 Years of Light-Pollution Measurements in Holland**
Wim Schmidt (Platform Lichthinder, Nederland)

The presentation will describe work carried out in the last 4 years to get data of the night sky in Holland with the help of digital cameras. Results will be presented of some 1500 measurements of an area covering around 40% of Holland. The results are presented in the form of maps for the local governments. The practical problems associated with using digital cameras for this purpose will be presented, also the correcting measurements I have done to obtain the best possible results using this simple method. The different atmospheric conditions are still a concern and I hope to present some possible solutions.

28. **Monitoring Night-Sky Brightness with a Lightmeter Network**
Günther Wuchterl, A. Müller and M. Reithofer (Thüringer Landessternwarte Tautenburg, Germany)

We report the first results of continuous measurements of horizontal illumination by the night sky with newly developed lightmeters (see http://lightmeter.astronomy2009), i.e. the instrument formerly known as the Luxmeter. The network is presently spread around Germany and Austria with a few nodes in the Atacama desert. We compare various strategies to quantify the results and to compare with other methods to measure light-pollution.

29. **A Simple Scale to Determine the Level of Light Pollution**
Thomas Graf and Zdenek Mikulasek (The Observatory and Planetarium of Johann Palisa, VSB-TU, Ostrava, Czech Republic)

This work presents a proposal to determine the relative scale of 'light pollution. The method is based on a simple analysis of data concerning the level of night lighting measured by a calibrated luxmeter. Such a relative scale can be also used in media for a so-called weather forecast. On the basis of the prognosticated cloudiness and rainfall it enables one to predict how dark the following nights will be. The study is an introduction to a deeper analysis which will be made after a longer period of measuring and getting data from another measuring site located in different environments (this site has been working just for a few months).

30. **The 'Light Pollution Challenge' Pilot: A 3-D Education Gaming Project**
Organized by Robert Hill (Northern Ireland Space Office, Armagh Planetarium, Armagh) with children from the following schools: St. Mary's Grammar School, Magherafelt, Co. Derry; St. Patrick's College, Maghera, Co. Derry; Carickfergus Grammar School, Co. Antrim; Loreto College, Coleraine, Co. Antrim; Belvedere College, S.J., Dublin; St. Dominic's High School, Santa Sabina, Dublin; De La Salle College, Churchtown, Dublin; and Gonzaga College, S.J., Dublin.

This session will feature short presentations from eight schools that have taken part in the all-Ireland pilot of the 'Light Pollution Challenge'. Pupils from Key Stage 3 in Northern Ireland (11–14) and Transition Year in the Republic of Ireland (15–16) were tasked to create 3-D environments/games using the topic of Light Pollution as the context for development and the learning outcomes. The objective was to develop a real 'game' that other pupils could use to learn about the topic and the different aspects of Light Pollution that impact on society and the environment. The pupils have been given only 3 weeks to prepare their projects, as this is the more realistic scenario that teachers would face in the classroom in developing such a product within the confines of daily curriculum delivery. The pupils will briefly discuss the learning outcomes and skills developed in the course of their game creation and time will be allowed for a quick Q&A to better understand how the pupils have coped with this type of learning in a short period of exposure to the new 'ThinkingWorlds' technology. All participants at the conference with an interest in Education and the possibilities flowing from inclusion of Light Pollution as a key interdisciplinary theme in the curriculum are encouraged to attend this parallel session.

31. **The Dark Skies Awareness Programs for the International Year of Astronomy: Involvement, Outcomes and Sustainability**
Dr Constance E. Walker (U.S. National Optical Astronomy Observatory)

The loss of a dark night sky as a natural resource is a growing concern. For this reason, 'Dark Skies' is a thematic cornerstone project of the United Nations-approved International Year of Astronomy (IYA 2009). Its goal is to raise public awareness of the impact of artificial lighting on local environments by getting people worldwide involved in a variety of dark-skies programs. To reach this goal, activities have been developed that teach about dark skies using new technology (e.g. podcasting, social networking, etc.) and provide thematic events on light pollution at star parties and observatory open houses (e.g. Dark Skies Discovery Sites, etc.), organize events in the arts (e.g. a worldwide photography contest), involve citizen-scientists in naked-eye and digital-meter star-hunting programs (e.g. GLOBE at Night, How Many Stars, etc.) and raise awareness about the link between light pollution and health, ecology, safety, economics, energy conservation and astronomy (e.g. The Starlight Initiative, International Dark-Sky Communities, Earth Hour, posters and brochures, etc.). The presentation will provide an update, showcase global events and programs, describe how people can become community advocates and take a look ahead at the program's sustainability beyond IYA 2009. For more information, visit www.darkskiesawareness.org.

32. **The IYA 2009 UK Dark Sky Parks Initiative**
Steve Owens (UK Coordinator for IYA 2009, Glasgow Science Centre, Scotland)

The Dark Skies Awareness cornerstone project of IYA 2009 has two main manifestations in the UK. Dark Sky Discovery community projects, and the Dark Sky Parks initiative. Steve Owens will highlight the second of these two projects, and describe the progress of Galloway Forest Park, which is set to submit its application to the IDA before the end of 2009.

33. **Public Lecture at Armagh Planetarium: "Exoplanets — The Hunt for the Earth Analogue"**

Dr Don Pollacco (Queen's University Belfast)

Over the last few years there has been unprecedented activity in the area of exoplanetary research. We now know of more than 300, mostly Jupiter-like, exoplanets. For about 60 of these we can characterize their most important parameters (e.g. mass, radius, density) and for a small number we are beginning to detect their atmospheres. The next decade promises to be extremely exciting and it is feasible that the first Earth analogue system could be discovered and characterized (including the search for signs of life in its atmosphere) using state of the art technology on the next generation extremely large telescopes.

Poster Papers, Exhibitions and Displays

1. **Preliminary Results of Night-Sky Brightness Using a Unihedron Sky Quality Meter (SQM)**
   Brian Espey (Trinity College, Dublin, Ireland), Michael O'Connell (Irish Federation of Astronomical Societies), Terry Moseley (Irish Astronomical Association, Belfast) and Joe McCauley (Trinity College, Dublin, Ireland)

   Preliminary results are presented from measurements of night-sky brightness ranging from inner-city environments to more distant dark sites within the island of Ireland. Comparisons will be made between these *in situ* measurements and the expected sky brightness as estimated from satellite images. Additionally, results will be reported from an interesting 'experiment' in which conditions both with and without a light pollution contribution were measured for one site which suffered a power cut!

2. **Dark-Sky Awareness in Spain: A Cornerstone Project for the IYA 2009 Spanish National Node**
   Fernando Jáuregui (Dark-Sky Awareness Coordinator and Astrophysicist of the Pamplona Planetarium)

   The cornerstone project "Dark Sky Awareness' is part of the activities led by the Spanish National Node for the International Year of Astronomy 2009. The programme includes: (1) light-pollution measurements and popularization activities (star-count method); (2) Globe at Night activities in 2009 March; and (3) the Investigación y Acción sobre Cielo Oscuro (IACO) activities, involving four national star parties around the times of the new moons of 2009 February, March and April in collaboration with groups of amateur astronomers to get some luminaires switched off. The main objective of the Third National Star Party was to look for places where the Milky Way is still visible. In addition, we have run a course for amateur astronomers at the Calar Alto Observatory, aimed at showing how to measure artificial sky glow, and undertaken a number of other activities.

3. **Luminous Flux Radiated by Public Lighting to the Upper Hemisphere**
   Thomas Novak (VSB-Technical University, Ostrava, Czech Republic)

   This article solves the problem of the luminaires for public lighting that are covered with flat glass. These luminaires are compared with luminaires that are covered with classical bowl diffusers and other luminaires for public lighting. The article compares the luminous flux radiated to upper hemisphere by different kinds of luminaires and different public lighting systems in the cities.

4. **Dark-Sky Awareness in Belgium: A Cornerstone Activity for IYA 2009**
   Friedel Pas (European Liaison Officer, IDA Europe and IDA Board Member)

   The poster describes one of the cornerstone activities of the International Year of Astronomy 2009, namely Dark-Skies Awareness. It was natural that the steering committee of the most light polluted country in the world should take this cornerstone seriously and put a significant amount of effort in their communications to the issue of light pollution. The main event was the 'Night of Darkness', which was held in the three regions of Belgium and where the majority of municipalities participated.

5. **IYA 2009 'From Earth To The Universe (FETTU)' Travelling Astronomy Poster Exhibition**

Miruna Popescu (Armagh Observatory) and Irish Astronomical Association (IAA, Belfast)

The FETTU travelling astronomy poster exhibition, featuring some of the best astronomical images ever taken, is part of the wider International Year of Astronomy (IYA 2009) FETTU project and part too of the all-Ireland FETTU exhibition part-funded by the Republic of Ireland's 'Discover Science and Engineering' (DSE) programme and by the Northern Ireland Department of Culture, Arts and Leisure (DCAL) through grant-in-aid to the Armagh Observatory. The exhibition has been displayed at various locations throughout Northern Ireland and the Republic of Ireland through the efforts and good offices of the Irish Astronomical Association (IAA) and the all-Ireland IYA 2009 Coordinator Miruna Popescu (Armagh Observatory). Major contributors to IYA 2009 activities throughout the island of Ireland include Ireland's DSE programme, the DCAL, the Northern Ireland Space Office at Armagh Planetarium, the European Southern Observatory, the Armagh Observatory and NUI Galway. For more information about the programme of activities organized for the International Year of Astronomy on the island of Ireland, or to book the travelling astronomy exhibition for your venue, please visit the website (http://astronomy2009.ie/) or contact the Armagh Observatory.

6. **IAA Display Stands**

Irish Astronomical Association, Belfast (http://irishastro.org/)

The Irish Astronomical Association was formed in 1974 and draws its 200 members from both the UK and Ireland. The IAA membership ranges from complete beginners to accomplished observers and astro photographers. The society organizes an active programme of meetings and astronomy lectures, held in association with the School of Mathematics and Physics, Queen's University Belfast, every fortnight from September to April. Meetings start at 7.30 pm sharp and usually consist of a short talk given by one of our members followed by the main lecture, usually given by a professional astronomer. Membership of the IAA costs £18.00 per year and entitles all the members of one family to attend IAA events including our regular speaker programme. New members are always welcome to join this active and extremely social group. For full details, see the web-site: http://irishastro.org/.

7. **IDA Display Stands**

International Dark-Sky Association (see http://www.darksky.org/page/iya2009/)

The International Dark-Sky Association travelling and trade show display (see http://docs.darksky.org/IYAdisplaybanner.pdf/) reviews many of the common myths of light pollution, such as "More Light is Better", "I am Safer in the Light", and that "Light Pollution Only Affects Astronomers". Presented in a visually friendly manner, the display is increasingly popular as an effective means of communication at large and small trades shows and council meetings alike.

8. **IFAS Display Stand**

The Irish Federation of Astronomical Societies (http://www.irishastronomy.org/)

The Irish Federation of Astronomical Societies (IFAS) is an umbrella organization of amateur astronomy clubs across the island of Ireland. Our aim is to promote the interests and development of amateur astronomical societies in Ireland. An example is our website http://www.irishastronomy.org/ which provides an online portal for astronomers across the island to share their hobby with like-minded individuals. Recent co-ordinated activities include the IYA 2009 cornerstone project '100 Hours of Astronomy', where twelve events were organized across the island (including Northern Ireland and the Aran Islands) to bring sidewalk astronomy to members of the public.

9. **Northern Ireland Environment Link Display Stand**

NIEL, 89 Loopland Drive, Belfast, BT6 9DW (http://www.nienvironmentlink.org/)

The Northern Ireland Environment Link (NIEL) is the forum, networking and information body for organizations interested in the environment of Northern Ireland. It works to influence policy and practice in ways that protect and enhance the environment at both the political and delivery levels. Major work areas include climate change, sustainable development, planning and environmental protection. It produces a wide range of publications and has just developed a new website which we hope will become a hub for all those interested in Northern Ireland's environment: see http://www.nienvironmentlink.org. NIEL holds events and conferences on environmental issues and encourages debate on controversial issues. It is an association of organizations across all environmental interests and ranging from local community groups to international charities and works across the full range of environmental issues including the natural and built heritage and environmental protection in all its aspects. Membership is open to charities (Full Membership) and to companies, government agencies and individuals (Associate Membership).

Biographical Notes on Principal Speakers

1. **Mark Bailey (Armagh Observatory)**

Professor Mark Bailey is an astrophysicist and the Director of the Armagh Observatory since 1995. Following an undergraduate degree in Physics at Cambridge and a Masters at the University of Sussex, he obtained a PhD in Astronomy at the University of Edinburgh in 1978 with a thesis on the evolution of active galactic nuclei, subsequently working at the Universities of Cambridge, Sussex, Manchester and Liverpool John Moores. In recent years his astronomical research has moved away from distant galaxies towards areas closer to home: the dynamical evolution of comets, asteroids and meteoroid streams; Solar System – Earth interrelationships; and aspects of the comet and asteroid impact hazard. The minor planet (4050), discovered in 1976 by C.-I. Lagerkvist, was named "Mebailey" in March 1990 for his work on the dynamics and origin of comets. He is the author, co-author or editor of nearly a hundred scientific papers and several books, the most recent "Border Heritage" (see http://scholars.arm.ac.uk/avec/border-heritage-book.html) describing the work of the Armagh Visitor Education Committee and the extraordinarily rich shared heritage of the City of Armagh and County Monaghan from roots in the distant past to the present. He is a former Council Member and Vice-President of the Royal Astronomical Society, holds the position of Honorary Professor at Queen's University Belfast, and was awarded an MBE for services to astronomy in June 2007.

2. **Peter Brabazon (Discover Science and Engineering [DSE], Dublin)**

Peter Brabazon is Programme Director, Discover Science and Engineering (DSE), Ireland's national science promotion programme. The overall objective of the DSE programme is to raise the level of the public's understanding of scientific and technological issues and to bring about a significant cultural shift in attitudes. The programme seeks to promote a positive attitude towards careers in science, technology engineering and mathematics (STEM). The programme is managed by Forf´as on behalf of the Office of Science and Technology and was developed in association with the Department of Education and Science, and the Institution of Engineers of Ireland in consultation with other groups, including policy, education and industrial interests, involved in science promotion nationwide. Peter was responsible for leading the Industry and general Energy Awareness programmes with Sustainable Energy Ireland before joining Forf´as in 2004. He is an electrical engineer and is from Dublin where he lives with his wife and two sons.

3. **Sue Christie (Northern Ireland Environment Link [NIEL], Belfast)**

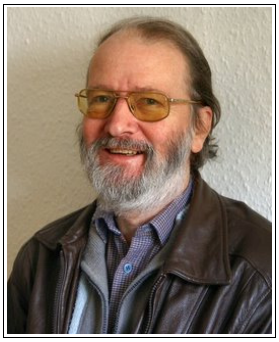
Professor Sue Christie has been the Director of NIEL, the networking and forum body for voluntary environmental organizations in Northern Ireland, since 1991. She is an ecologist, originally from the USA, with an MSc and PhD in Ecology and Behavioural Biology. She has a wide range of environmental interests and has been involved in a number of voluntary organizations, government committees and working groups on a variety of environmental matters. She is currently an independent member of the Strategic Waste Board, on the NI Climate Change Impacts Partnership and the Boards of Action Renewables, Sustainable NI and Tidy NI. In addition to work in Northern Ireland she is involved in an environmental education project and ecological research on Soqotra Island, Yemen. She is Visiting Professor at the Department of Environmental Sciences at the University of Ulster, Coleraine and a tutor in

environmental planning at Queen's University Belfast. She is a Member of the Institute of Ecology and Environmental Management and a Chartered Environmentalist and was awarded an OBE in December 2008.

4. **Apostolos Christou (Armagh Observatory)**

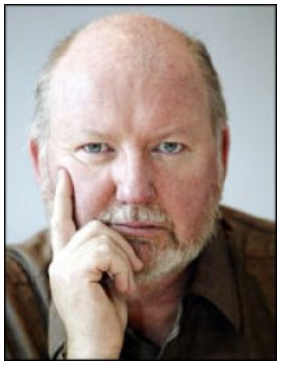
Apostolos 'Tolis' Christou is a Research Astronomer at Armagh Observatory with largely theoretical interests in solar system dynamics. He is interested in the characteristics and stability of co-orbital motion (small bodies in 1:1 mean-motion resonance with planets), both now and in the past, and with colleagues has demonstrated the existence and dynamical robustness of hitherto unknown modes of co-orbital motion, which appear only at high eccentricities and inclinations. He also studies the possibilities for observing meteors in the atmospheres of Mars and Venus, which can extend our knowledge of the meteoroid complex to sizes ranging up to dm. In addition to promoting various 'mutual event' campaigns, he is currently working on dynamical models of the evolution of the irregular satellites systems of the gas giants.

5. **Graham Cliff (University of Manchester)**



Graham Cliff is presenting a joint paper with Colin Henshaw (Tabuk, Saudi Arabia), which aims to develop a broad understanding of what today is called 'light pollution'. This is no more than a symptom of the modern 24-hour day. Graham Cliff obtained his first degree in Physics and Electronic Engineering at the University of Manchester, after which he became what is now described as a nanotechnologist in Materials Science in 1971. His career goal was to analyse at atom-detection limits using the analytical electron microscope (AEM). Material Scientists around the world now employ his Cliff-Lorimer k factors in AEM analysis. He has been an amateur astronomer since 1957 and is now an Honorary Senior Research Fellow in the School of Earth, Atmospheric and Environmental Sciences at the University of Manchester. He hosts the anti-light-pollution/light-at-night (LP/LAN) web-site at http://www.lightpollution.org.uk.

6. **Leo Enright**



Leo Enright is an Irish radio broadcaster and news reporter with special interests in science, and astronomy and space science in particular. He is currently a member of the Governing Board of the Dublin Institute for Advanced Studies, and has recently completed a period serving as Chairman of Ireland's Discover Science and Engineering (DSE) programme.

7. **Brian Espey (Trinity College Dublin)**

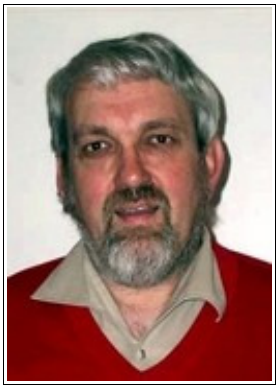
Brian Espey has been interested in astronomy since his teens, and has been an member of various astronomical societies since that time, including 30 years as a Fellow of the Royal Astronomical Society. Brian obtained a BA in Experimental Physics from Trinity College Dublin, before working for the SERC at the Rutherford Appleton Laboratory. Following a PhD in astronomy at the University of Cambridge, he worked as a Royal Society Science Exchange Fellow at the University of Leiden, before moving to the two further postdocs at the University of Pittsburgh and the Johns Hopkins University (JHU). At JHU Brian was involved in the Astro-2 Space Shuttle

astronomy mission, before moving to the Space Telescope Science Institute as an Assistant Astronomer working for the European Space Agency. Since October 2001 Brian has been a permanent staff member in the School of Physics in Trinity College Dublin, where he has supervised the building of an optical and radio teaching observatory and the development of a growing astrophysics section.

8. **Tomas Graf (The Observatory and Planetarium of Johann Palisa, VSB-TU, Ostrava, Czech Republic)**

Tomas Graf graduated in physics at the Faculty of Science, Masaryk University in Brno and later also obtained a PhD there (Theoretical Physics and Astrophysics). Since completing his studies he has worked at the Observatory and Planetarium of Johann Palisa, VSB-Technical University of Ostrava, becoming the head of this department in 1992. Externally he also teaches Fundamentals of Astronomy and Astrophysics at the University of Ostrava, and Practical Astronomy and Popularization of Astronomy at the Silesian University in Opava.

9. **Andreas Hänel (Osnabrück Planetarium)**



Studied physics and astronomy at Bonn University (1972–1986), with observing runs at different observatories. 1986 Post-doctoral research position at the Max-Planck Institute for Astronomy, Heidelberg, then director of the planetarium in the Natural History Museum am Schölerberg, Osnabrück and observing with the 60cm telescope of the local astronomy association. Has been working on light pollution since 1993.

10. **Colin Henshaw (Tabuk, Saudi Arabia)**

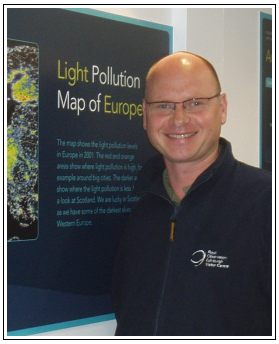
Colin Henshaw is co-author of the paper presented by Graham Cliff (University of Manchester), which aims to develop a broad understanding of what today is called ‘light pollution’. Colin Henshaw, a teacher and world-renowned variable-star astronomer, obtained his first degree in Zoology in 1972. He now teaches English Language, Anatomy and Physiology, and Pathology at a training centre in a hospital in Tabuk, Saudi Arabia. He once taught in Kadoma, Zimbabwe, where he co-discovered Supernova 1987A. His interest in the environmental harm of light pollution resulted in a letter to the Journal of the British Astronomical Association in 1994. Many of his predictions from that letter are to be seen happening in the natural environment today.

11. **Robert Hill (Northern Ireland Space Office, Armagh Planetarium, Armagh)**

Robert Hill is the Director of the Northern Ireland Space Office, based at the Armagh Planetarium (see http://www.armaghplanet.com/html/niso.html). He has spearheaded the campaign to bring astronomy and space-science topics to teachers and pupils through the newly revised curriculum in the province. He is currently co-ordinating the creation of thematic units with regional government and the Council for Curriculum, Examinations and Assessment to align the latest astronomy and space related resources to accredited and integrated education. Robert is an educational consultant with the UK Yorkshire based Space Connections group, and part of the original UK team tasked with the possibility of creating a European Space

Education Resource Office structure in Northern Ireland and throughout the UK. In his previous post as Business Manager and Science Communicator for Armagh Planetarium, he designed and created the 'From Earth to the Heavens' exhibition and has worked with several other science centres to help in the realization of exciting and stimulating European space related exhibitions. During this period he also became the Faulkes Robotic Telescope Project schools coordinator in Ireland and helped bring this resource (in collaboration with the British Council) to several other regions including Portugal and Russia. He founded the Astrogazers Ireland Astronomy schools network, working with teachers to gain confidence in using astronomy resources for the classroom. Robert is a member of many European and Global wide working groups and panels including author of Astronet Panel E 'Education, Outreach and Recruitment' elements 'Relationships with Industry' and 'Planetaria and Museums'. He was also part of the team evaluating the European Southern Observatory public outreach and educational material. He is currently a member of the International Astronomical Union Executive CommitteeWorking Group for International Year of Astronomy 2009 and a member of the UNESCO Space Education Team to Tanzania and Nigeria. His present duties include liaison with the local government in Northern Ireland to explore the possibility of using astronomy and space science as a key skills developer for adults returning to education and project management and coordination of the Yorkshire Planetarium refurbishment. He is committed to encouraging regional industry and business to recognise the potential offered by engagement with the space industry through the global space agencies, either as partners involved in development of resources, or training to create a human resource capability able to compete effectively in the global markets to the highestspecifications and technology.

12. **Dan Hillier (Royal Observatory Edinburgh, UK Science and Technology Facilities Council, Scotland)**



Dan has been Visitor Centre Manager at the Royal Observatory Edinburgh (ROE) since 2000. From Bristol, he is a history graduate with a professional background in environmental interpretation and museum management. Working at Manchester Metropolitan University he was involved, through advisory, training and consultancy work, in supporting environmental and heritage organisations in developing their approaches to 'environmental interpretation', drawing especially on ideas from North America about how significant outdoor sites are presented and explained to visitors. From 1994–1997 he coordinated the Environmental Initiative for the Scottish Museums Council, which supported 13 education projects involving museums and local environmental organisations. On joining the ROE, he led new teacher training programmes that have been attended by some 1,000 teachers from most of the local authorities in Scotland. This involved running Scotland's first residential training events for primary school teachers of science, to train some 50 teachers to run workshops for colleagues in their own schools. In 2007 he led the creation of the Dark Sky Scotland partnership, involving the Forestry Commission Scotland, Careers Scotland and Glasgow Science Centre, among others. In 2008, following the success of the Scotland programme, he established the steering group for the Dark Sky Discovery programme for the UK and Ireland as an IYA2009 project. His role at the ROE also includes managing Public Relations for the site.

13. **Fernando Jáuregui (Dark-Sky Awareness Coordinator and Astrophysicist of the Pamplona Planetarium)**

Fernando Jáuregui is an astrophysicist at the Pamplona Planetarium and IYA2009 Dark-Sky Awareness Coordinator. He has worked in the education and production department of the Pamplona Planetarium since 1992 and regards the fight against light pollution as a essential part of his job, access to the night sky being an essential tool to explain the stars on show in the planetarium. As he puts it, "They pay me to teach Astronomy and in return I must convince them to light properly in order to allow me to do my job." That's why I'm here, enjoying my job, studying sky glow, and undertaking a number of other activities.

14. **Simon Jeffery (Armagh Observatory)**

Educated in Edinburgh and London, Dr Simon Jeffery obtained his PhD for a theoretical study of stellar structure and evolution at the University of St Andrews. During fellowships in Kiel, Germany and St Andrews, he learnt techniques of observational astronomy including photometry and spectroscopy from the ultraviolet to the infrared, much of it using small telescopes. He also developed expertise in the physics of pulsating stars and stellar atmospheres. Since moving to the Armagh Observatory in 1996, Simon has led a successful group studying the evolution of highly-evolved stars, frequently based on observations of stellar variability from a wide range of telescopes. He is currently a senior research astronomer at the Armagh Observatory, chairman of the Astronomical Scence Group of Ireland, and a visiting academic at Trinity College Dublin, where he lectures in Stellar Structure and Evolution.

15. **Steven Lockley (Harvard Medical School)**

Dr StevenW. Lockley PhD is an Assistant Professor of Medicine at Harvard Medical School and an Associate Neuroscientist, Division of Sleep Medicine, Brigham and Women's Hospital, Boston. He received his BSc degree in Biology from the University of Manchester in 1992 and a PhD in Biological Sciences from the University of Surrey in 1997. He has 15 years experience on basic and applied aspects of human circadian biology with a particular interest in human circadian photoreception and the effects of light on the circadian pacemaker and other non-image forming responses. Studies include investigations of the effects of timing, duration, intensity and wavelength of light exposure on circadian resetting, melatonin suppression and the acute alerting effects of light. His group has also recently begun to examine the role of visual impairment on endocrinology and breast cancer risk in blind women.

16. **Dorien Lolkema (National Institute for Public Health and the Environment, The Netherlands)**

Dorien Lolkema is a physicist and researcher in the field of air quality and remote sensing. Working with different kinds of remote sensing techniques like lidar and DOAS, she has been busy in satellite validation, and nowadays works on air quality forecasting and night-time light emission. She is actively involved in the European initiative GMES (Global Monitoring for Environment and Security), and concerning night-time light emission works primarily on measuring night-time light emission by satellites.

17. **Paul Marchant (Leeds Metropolitan University)**

Paul Marchant works in statistics. He started out in physics/astrophysics and indeed continued to teach the Open University's 'Relativity and Cosmology' course for 17 years. Astrophysics got him seriously into statistics, and so after his PhD he studied the subject to MSc level and was later awarded Chartered Statistician status. He supports research across a variety of disciplines at Leeds Metropolitan University and produces a range of publications. Has taken part in the UK Universities Research Assessment Exercise in 2001 (education) and 2008 (health), and has been a (Crown Court) expert witness in statistics. He has contributed to the Government's Reviews of Science and takes an interest in evidence-based policy generally. He is an active member of the Royal Statistical Society, recently being a member of its Medical Section and currently the chair of the Leeds and Bradford local group. Some of his material is available at: http://praxis.leedsmet.ac.uk/praxis/Publications/publicationsmarchant.htm.

18. **John Mason (South Downs Planetarium, Chichester)**

John Mason is a past president of the British Astronomical Association and a founding trustee of the South Downs Planetarium Trust, a hundred-seater planetarium and science centre in Chichester, West Sussex. He is a greatly sought after public speaker with an international reputation as an enthusiastic and entertaining communicator of science. He has travelled extensively in the UK and overseas, notably chasing total solar eclipses and exceptional meteor showers, and observing the polar aurorae or Northern Lights. In the course of his work he has made numerous appearances on radio and television, produced a large number of television series and documentaries, edited technical books, and published many technical papers in peer-reviewed scientific journals. He has appeared more than a dozen times with Patrick Moore on the long-running BBC TV series 'The Sky at Night'.

19. **Tom Mason (Armagh Planetarium)**

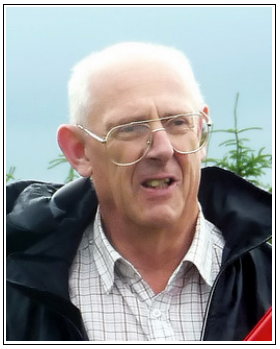
Tom Mason is a geologist and has been director of Armagh Planetarium since August 1996. He studied at Queen's University Belfast and his undergraduate degree in 1971 was followed by research into the Carboniferous palaeoenvironments of west Fermanagh which earned him a PhD in July 1974. From July 1974 to August 1996 he worked in South Africa as an academic geologist, researcher and consultant: he was promoted from Lecturer to Senior Lecturer, and from Associate Professor to ad hominem Research Professor and Director of the Marine Geoscience Unit at the Department of Geology & Applied Geology at the University of KwaZulu-Natal (UKZN). Based at the Durban campus of UKZN Tom's research and consulting interests encompassed a diverse range of topics including dinosaurs and mammallike reptiles, trace fossils, coal deposits, diamond deposits on the African south-west coast, Namibian desert palaeoenvironments, and coastal zone geology and geomorphology. He is the author of over 100 scientific papers. In 1996 he returned to Northern Ireland as Director of Armagh Planetarium (http://www.armaghplanet.com). Since then he has driven a programme of rebuilding, refurbishment and re-investment, and the rebuilt Armagh Planetarium re-opened to the public in August 2006. Honoured with the award of an MBE in March 2006 for his services to astronomy education in Northern Ireland, he planned Armagh Planetarium's rebirth. He has a long-term interest in working with young people and special-needs children and served as the Department of Education's representative governor of Lisanally Special School. He has been active in adult education and life-long learning throughout his

professional career, running special palaeontology field trips for interested amateurs in South Africa, and working with community education groups. He served as President of the British Association of Planetaria from 2005 to 2008 and is currently the President the International Planetarium Society.

20. **Bob Mizon (Coordinator, Campaign for Dark Skies)**

Bob is a graduate in modern languages, but is much better known as an astronomer. Having taught French for 26 years, he embarked on a daring career change in 1996. Responding to a lifelong passion for astronomy, he is now a planetarium operator, taking a mobile dome in to schools, youth groups and societies all over southern England. Over 100,000 people have experienced a tour of the Universe with Bob at the controls. Bob is best known in the scientific and environmental community as the co-ordinator of the British Astronomical Association's Campaign for Dark Skies, which aims to turn back the tide of light pollution which has seriously affected our view of the stars over the last fifty years. Glare, light intrusion and skyglow have become the norm nowadays, a situation hardly compatible with a society which is supposed to be saving energy and protecting the environment. Bob was elected a Fellow of the Royal Astronomical Society in 1985, and has been associated with the Wessex Astronomical Society in various offices for many years. An active observer of the night sky, Bob lectures to astronomy societies and groups all over the country. Bob writes astronomy books and translates them from French.

21. **Terry Moseley (Irish Astronomical Association, Belfast)**



Terry Moseley has been active in amateur astronomy for over 40 years, having concentrated his observing on Jupiter, Saturn, meteors and variable stars, with a variety of telescopes up to 37 cm aperture. He has served the maximum of three spells of 3 years each as President of the Irish Astronomical Association (IAA), and has held many other posts in that organization, of which he is currently PR Officer. The IAA has honoured him with its two awards: the Fitzgerald Medal, and the Öpik Award. He was also elected as a Fellow of the Royal Astronomical Society. He served as Interregnum Director of Armagh Planetarium for four months in 1969, and was the founder and first president of the Irish Federation of Astronomical Societies (IFAS). He has authored a book on astronomy and space exploration for schools, namely "Reaching for the Stars" (Pergamon, 1974), and has written many other articles for various astronomy publications. He is currently on the editorial advisory board for the BBC's Sky at Night Magazine, and appeared as the guest on a Sky at Night programme on observing Jupiter. He has appeared as guest astronomer on many other TV and radio programmes on astronomy, and has given lectures on the subject to a wide variety of astronomical societies and other organizations. He recently served on the Committee for Astronomy and Space Research of the Royal Irish Academy, and the organizing committee for IYA2009 in Ireland. He has acted as adviser on, and assisted with, various aspects of the restoration of the great 72-inch Reflector at Birr Castle. His current interests include light pollution, total solar eclipses, and archaeoastronomy. He was honoured by the International Astronomical Union by the naming of an asteroid in his honour "(16693) Moseley".

22. **Sean Noone (Managing Director, Superior Electronic Lighting Controllers (SELC) Ltd, Ireland)**

Sean Noone is Chairman and Managing Director of SELC Ireland Ltd, based in Belmullet, Co Mayo, Ireland. SELC is now one of the top suppliers of Public Lighting Control products on the International Lighting Market, specializing in streetlighting controls and a pioneering dimming system with the potential for significant energy savings and reduction of light pollution. Sean was winner of the prestigious 1999 National Innovation Awards and in 2003 was selected as Mayo Person of the year. He is a member of the Electro-Technical Council of Ireland, and the National Standards Authority of Ireland, and is a two-term past Chairman of the Institution of Lighting Engineers, Ireland North and South. Sean is also heavily involved with the European E-Street programme. The SELC company web site is www.selc.ie.

23. **Nobuaki Ochi (Yonago National College of Technology, Japan)**

Nobuaki Ochi has been teaching physics at Yonago National College of Technology, Japan. He obtained his doctorate on the subject of cosmic-ray physics. Having great interests in space science and environmental problems, it was natural for him to start studying light pollution. During the last two years he has introduced educational materials concerning light pollution into his physics lectures.

24. **Michael O'Connell (Irish Federation of Astronomical Societies)**

Michael O'Connell is the Chairperson of the Irish Federation of Astronomical Societies (http://www.irishastronomy.org) and the Chairperson of the Midlands Astronomy Club (http://www.midlandsastronomy.com). Michael is an amateur astronomer living in Kildare whose main interests are in astrophotography, solar astronomy and meteorites. Michael is the author of the IFAS Observing Handbook "The Messier Objects Observing Challenge".

25. **Steve Owens (Glasgow Science Centre, Scotland)**

Steve Owens is the UK Coordinator for IYA2009, based at the Glasgow Science Centre, Scotland. He is leading the Dark Sky Parks initiative.

26. **Bob Parks (Washington DC Office Managing Director, International Dark-Sky Association)**

Bob Parks is founder of the Virginia Outdoor Lighting Taskforce (VOLT), an all-volunteer, non-profit, grassroots advocacy group since 2000. Its mission is to promote safe and efficient outdoor lighting. VOLT has been successful helping localities in Virginia to enact lighting ordinances and was instrumental in the passage of legislation to require that all state facilities purchase only full cut-off fixtures. Mr Parks is also an avid amateur astronomer and past president of the Northern Virginia Astronomy Club, the largest of its kind in the United States. He has been a member of International Dark-Sky Association since 2000. In 2005, he founded the Almost Heaven Star Party at Spruce Knob, WV, one of the darkest observing sites on the East Coast. In March 2009, he joined the IDA to launch the Washington Office for Public Policy and Government Affairs. As managing director, he is charged with keeping Congress and federal agencies up to date regarding IDA's mission and its issues. In addition, he is working to build a coalition of environmental and energy organizations that have parallel goals to reduce light pollution, conserve energy, and preserve the natural environment.

27. **Friedel Pas (International Dark-Sky Association Board Member, IDA Europe)**

Friedel Pas has been fighting light pollution since 1990. In 1993, he joined the workgroup Werkgroep Lichthinder, which founded and still runs the pioneering lights out event, the Belgian Night of Darkness, which enjoys over 62% participation from Belgian municipalities. In 2004, Friedel became president of Preventie Lichthinder, which set up collaborations with the Belgian government and currently runs the Belgian Night of Darkness. As current European Liaison, Friedel has been invaluable in organizing and promoting IDA programs throughout Europe, including the European Symposium. Friedel is the winner of the 2008 Hoag-Robinson Award.

28. **Kim Patten (Programs Director and Public Affairs, International Dark-Sky Association)**

Kim has been working to protect the night for over three years. As primary coordinator for events and conferences she's had the honour of organizing the IDA Annual Conference, Business Meeting, and The Night Symposium. An active participant in the International Dark-Sky Places committee, she enjoys working directly with night-sky conservation efforts. Kim is a member of the American Planning Association, the Urban Land Institute, and the International CPTED Association. Kim is a proud graduate of the University of Arizona. Her undergraduate work is in Political Science and European History and her graduate work in Urban and Environmental Planning. She has presented "Night? In the City" a paper by Dr. David L. Crawford at the Light Pollution & Urban Lighting symposium hosted by Istanbul Kultur University and been published in the International Federation of Park and Recreation Administration's "IFPRA World" Magazine on the International Dark Sky Parks program.

29. **Don Pollacco (Queen's University Belfast)**

Don Pollacco gained his undergraduate degree and PhD at the University of St. Andrews, subsequently working first as a Postdoctoral Research Assistant there and then as a University Lecturer in the Liverpool John Moores University (1992–1995). He then spent five years as Staff Astronomer at the Isaac Newton Group, La Palma, Canary Islands; and has been at Queen's University Belfast since 2000, where he is now Professor of Astrophysics. He is the Project Scientist and originator of the Wide Angle Search for Planets (WASP) project.

30. **Miruna Popescu (Armagh Observatory)**

Miruna has over ten years of experience as a researcher in solar physics, including a PhD at the Armagh Observatory. Her most important result was to show that the tiny explosions in the Sun's coronal holes force plasma upwards and are the origin of the fast solar wind. In recent times she has expanded her work in the public understanding of astronomy and is currently the outreach coordinator for the International Year of Astronomy in Ireland.

31. **James Hoban Rickard (Astronomer, and Member of the Borrego Springs Dark Sky Committee)**

James Hoban Rickard obtained his MS and PhD in Astronomy and Astrophysics at the University of Maryland, specializing in the structure of our galaxy. After a postdoctoral year at California Institute of Technology, he worked for six years as a staff astronomer at the European Southern Observatory in Chile. After returning to the USA, he took a position at the Clark Lake Radio Observatory in Borrego Springs, California. Most recently he taught cosmology and natural science to future teachers at San Diego State University. Now retired, he lives in Strokestown, Co. Roscommon in the home country of his grandparents.

32. **Wim Schmidt (Platform Lichthinder, Nederland)**

Wim Schmidt grew up in the darkness of the north of Holland, and was initially drawn into studying astronomy by his uncle. Later he switched to psychology. He worked for twenty years in art education, but in the last ten years he has returned to his old love and founded the Dutch light pollution organization. He has obtained a number of assignments from different regional administrations to help reduce light pollution in the different parts in the Netherlands.

33. **Emma Stone (University of Bristol)**

Emma Stone (Webpage: http://www.bio.bris.ac.uk/people/staff.cfm?key=1251) has been working in the field of conservation biology for over 13 years. After completing her undergraduate degree she worked in Zambia for five years as Assistant Research Coordinator on the Biodiversity Project in Kafue National Park and Project Manager at Munda Wanga Wildlife Park. During this time she was involved in many different projects carrying out field research on a variety of species. Emma completed her Masters degree in Conservation Biology in 2005, conducting a thesis on techniques for estimating Brown hyaena (Hyaena brunnea) densities in and outside protected areas in South Africa. Since then she has worked as an Education Display Coordinator for the Philippines project

at Chester Zoo; Project Coordinator for the Mammal Society's National Small Mammal Monitoring programme; research intern studying the impact of domestic cats on wildlife in Bristol; and as an independent consultant for ecological consultancies. She returned to Africa for four months in 2006 as an Assisting Ecologist researching African wild dogs (Lycaon pictus). She began her PhD in December 2006 after recognizing the huge increase in development projects affecting bats together with a lack of scientific research on the impact of such development. She is very much an applied conservation biologist, with an interest in the conservation implications of human disturbance and wildlife conflict issues.

34. **Constance E. Walker (U.S. National Optical Astronomy Observatory)**

Dr Constance E.Walker is an associate scientist and senior science education specialist at the National Optical Astronomy Observatory in Tucson, Arizona, USA. She has the privilege of directing the International Year of Astronomy's Dark Skies Awareness Cornerstone Project, as well as the GLOBE at Night Program, and of working with the dedicated task groups for both projects.

35. **Albert White (Irish Light Pollution Awareness Campaign)**

Albert White runs the Irish Section of the IDA, the Irish Light Pollution Awareness Campaign. He holds an undergraduate degree in Computer Science from University College Dublin and a Master of Science in Astronomy from Swinburne University of Technology, Melbourne, Australia. Albert is a member of South Dublin Astronomical Society and currently works as a software engineer for Sun Microsystem in Dublin. He is a former Chairperson of the Irish Federation of Astronomical Societies and was elected as a Fellow of the Royal Astronomical Society in 2005.

36. **GüntherWuchterl (Thüringer Landessternwarte Tautenburg, Germany)**

Günther Wuchterl was born in Vienna and has been a scientist at the University of Heidelberg, Germany; the University of California Santa Barbara, USA; the Technical University, Vienna, and the University of Vienna, Austria; and the Max-Planck-Institute for Extraterrestrial Physics in Garching, Germany. His main work area includes the theory of the emergence of celestial bodies, star and planet formation. Günther is working on the search for extrasolar planets with Eike Günther (Thüringer Landessternwarte Tautenburg) and the search for planets with brown dwarfs, and with Ralph Neuhäuser (AIU Jena) on the first direct imaging of a planet orbiting another star. Günther participated in the rescue of the historical Kuffner observatory in Vienna, and has led a national public campaign for the determination of the light contamination in Austria.

37. **Zoltán Kolláth (Konkoly Observatory, Budapest, Hungary)**

Zoltán Kolláth obtained his degree in 1986 at the Physics and Astronomy Department of Eötvös Loránd University. In 1990 he was awarded a PhD and in 2003 became a Doctor of the Hungarian Academy of Sciences. He has been working at the Konkoly Observatory of the Hungarian Academy of Sciences from 1987 and was the deputy director of the institute from 2000–2005. He is the president of the Hungarian Astronomical Association, and a member of the International Dark-Sky Association, the International Astronomical Union and the Lighting Society of Hungary.