

nightscape

A PUBLICATION OF THE INTERNATIONAL DARK-SKY ASSOCIATION



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Dear Members,

IT'S A THRILL to address you for the first time as the executive director of IDA. I want to thank the IDA Board for the support it has shown during the last several months, while I served as interim executive director. I would also like to acknowledge Dave Crawford and Tim Hunter for the hard work and vision they provided that has shaped IDA into the night sky authority it is today.

For many non-profit organizations, the last year has been very difficult. The economy is showing some signs of recovery, but everyone is still feeling the pinch. As a result, the IDA budget was hit hard. The IDA staff is doing more with less, and we continue to make real strides with federal legislation, developing coalitions with other environmental organizations, Dark Sky Places, the MLO and scientific research. However, there is so much more to do. If you are able, please making consider a tax-deductible donation to IDA now.

We are working hard to grow the membership and increase revenue. Recently, over 500 new members have been added to our ranks thanks to the help of *Sky & Telescope* magazine and a dedicated volunteer. We are now looking to broaden our focus to appeal to the environmental and conservation movements to raise awareness of our night sky preservation mission. In order for IDA to grow and prosper, new ways must be found to reach the general public. Quality outdoor lighting needs to be understood by more people in order for it to become commonplace. I implore all of you to focus our combined energies on finding innovative ways to spread the message and attract support.

Toward that goal, the IDA Web site is undergoing a redesign. Soon a wiki (an easily modified, collaborative Web site) will be launched to consolidate all information related to night sky preservation and quality outdoor lighting. It can be revised and updated by anyone who has new information to share. This resource will be available to the media, students and researchers to rapidly spread new information. We hope it will make it easy for anyone to find answers quickly.

Volunteers have always been the bedrock of the dark sky movement. They will also be the key to growing our base and reaching beyond our traditionally strong astronomy community support. Please consider becoming a volunteer and help raise awareness in your community. In this time of tight budgets, we can use a lot of assistance. If you have some time to devote, let us know. Send an e-mail to ida@darksky.org and let us know about your skills and interest and what you can do to further our mission. You don't have to spend a lot of time to make a real difference.

Finally, our most important initiative is to improve communication with our members. We truly value your support and we want your feedback. Let us know what is important to you, what you think we are doing right, and what we can do better. I encourage you to join the new IDA Outdoor Lighting Forum on YahooGroups and ask questions and participate in the ongoing discussion on how to improve outdoor lighting and preserve the night sky. Please visit <http://groups.yahoo.com/group/IDAOLF/join>



Bob Parks
Executive Director

On the Cover: Jim Goldstein is an independent photographer specializing in landscape, travel, and nature. Light Lasso was taken during a new moon in Death Valley National Park. Ever conscious of light pollution, Jim timed his trip to capture the dark night sky in a series of fine art photos taken on the Racetrack Playa.

This photo used a Canon 1Ds Mark III digital SLR on a tripod. Light painting used LED flashlights and required a well-choreographed sequence of lights and motions to fit within a 30-second exposure. www.jmg-galleries.com



The mission of the International Dark-Sky Association (IDA) is to preserve and protect the nighttime environment and our heritage of dark skies through environmentally responsible outdoor lighting. IDA was incorporated in 1988 as a tax-exempt 501(c)(3) nonprofit organization. (FIN 74-2493011)

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Writer & Editor Rowena Davis
Outreach & Education Manager Johanna Duffek
Art & Design Stephanie Mar
Technical Associate Matthew Root

IDA Public Policy & Governmental Affairs

Executive Director Robert Parks
Associate Director Milton Roney

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Address corrections admin@darksky.org
Advertisements & submissions editor@darksky.org
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CONTACT

Address International Dark-Sky Association,
3225 N. First Ave., Tucson, AZ 85719-2103, U.S.A.
Tel +1 520 293 3198 Fax + 1 520 293 3192
Web site www.darksky.org E-mail ida@darksky.org

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MEETING NEWS

Washington DC, USA

VISITORS TO THE National Air and Space Museum in Washington, DC were treated to a number of informational booths, including an IDA display, on 17 April. Milt Roney, the associate director of IDA's Washington office, spoke with visitors from around the globe. In an exchange with the director of the National Observatory in Turkey, a visitor to the NASM, Mr. Roney learned that light pollution is seen as a problem in Turkey as well. Follow-up exchanges are being planned.

Suffern, NY USA

BOB PARKS, MILT Roney and volunteer John Nusbaum traveled to Suffern, New York to represent IDA at the Northeast Astronomy Forum (NEAF) from 17–18 April. They were joined by board members Kelly Beatty and Dr. Mario Motta. Over 130 exhibitors were present, displaying everything from 50 inch telescopes to 3mm eyepieces, none of which, it was clear, would work without dark skies. Mr. Beatty distributed orange “IDA Member” stickers, which were soon to be seen throughout the forum on both new members who signed up on the spot, and proud long-term members.

Frankfurt, Germany

IDA TECHNICAL STAFF Pete Strasser and Matt Root travelled to Frankfurt, Germany to attend and display at the biannual Light+Building trade show from 15–20 April. It is the largest of its kind in the world, with attendance this year eclipsing 180,000 visitors. IDA is the only non-profit organization given space to display.

“I was most impressed by the substantial increase in full cutoff products being made available,” said technical director Pete Strasser. “Manufacturers are responding to the market as energy waste and environmental concerns have become global issues.”



Technical associate Matt Root greets people at the IDA booth at Light+Build.

Several manufactures have committed to joining IDA's Fixture Seal of Approval program. “We have agreements with companies in Slovenia, Italy, Austria and more,” technical assistant Matt Root explained. IDA is truly international in scope, and the industry is seeing the benefit of being associated with the organization.

Mr. Strasser has received subsequent invitations to speak at future lighting shows in China, Dubai, and at the next event in Frankfurt in 2012. IDA had help in the booth by Bob Parks, German Chapter members Andreas Hänel and Wim Smit from the Netherlands.

Romeoville, IL USA

THE ILLINOIS COALITION for Responsible Outdoor Lighting teamed with Lewis University to present Illinois' first public symposium on the issues surrounding outdoor lighting on 11 March 2010. The event drew attendees from municipal management, conservation and astronomy groups, education and research, and the general public, filling the lecture hall at the university to nearly standing room only. Pete Strasser, the event's first topic speaker, discussed “Environmental Consequences of Contemporary Lighting Practices.” The day's lectures presented an overview of the diverse problems related to current outdoor lighting practices and looked at real-world, practical solutions.

Las Vegas, NV USA

THE 2010 LIGHTFAIR International from 11–14 May featured over 450 companies and boasted the highest number of attendees in the event's history. The number of outdoor lighting companies that manufacture dark sky approved fixtures is rapidly increasing. Attendee Matt Root feels sure this trend will become a standard in the industry. The vast majority of outdoor lighting exhibitors displayed the IDA logo at their booth, indicating that IDA has influenced the industry greatly in a short period of time. The number of dark sky friendly devices, controls, and retrofits has also grown.

Munich, Germany

IDA BOARD MEMBER Friedel Pas discussed ways illuminated signs can become more dark sky friendly as an invited speaker at the European Sign Summit (ESS) held 23 June in Munich, Germany. The ESS covers issues impacting, challenging and confronting the sign market through the recession, and lays the groundwork for changing energy needs and emerging social concerns. Darker skies are becoming a widely recognized goal in Europe, and the sign industry wants to integrate these concerns into its future.

UPCOMING EVENTS



MARK THE CALENDAR for 3 & 4 September and the 10th Annual

European Symposium for the Protection of the Night Sky. The 2010 symposium will be held in Kaposvár, Hungary, close to the Zselic National Landscape Protection Area, one of Europe's first International Dark Sky Parks. The program will feature several sessions dealing with all aspects of obtrusive light. Emphasis will be given to the question of how architects can avoid bad lighting on specialty buildings. Transportation from the 3rd International Symposium for Dark Sky Parks on Croatia's Lastovo Island is available.

Proposed energy legislation zigzags toward better outdoor lighting

By Milton Roney
Associate Director, IDA Washington Office

While many IDA members are legislative warriors in the campaign to preserve the night sky, others are new to the legislative process. Veteran and novice alike may gain insight on the complexities of Federal action from this report on IDA's ongoing involvement in Federal energy legislation.

IDA BOARD MEMBER Terry McGowan worked with industry groups on outdoor lighting legislation long before the 2009 opening of the IDA Washington Office. Partly because of his efforts, Representatives Jane Harmon (CA) and Fred Upton (MI) introduced a bipartisan outdoor lighting bill, HR 1732,¹ the Outdoor Lighting Efficiency Act days after the opening of the new office. The bill's main purpose was to save money and energy by replacing existing outdoor fixtures with more energy efficient luminaires.

The bill would have significantly decreased light pollution from new luminaires. Unfortunately, the efficacy measure chosen to determine the efficiency of outdoor lighting counted *all* the light emanating from the fixture, including uplight. This metric penalized shielded luminaires and rewarded bare light bulbs. Also, the legislation did not address issues of spectral power distribution or high color correlated temperature of solid state lighting. Seen as an obscure technicality by most laymen, high color temperatures could significantly affect human and animal circadian rhythms and increase light scatter.²

Washington Office staff met with industry groups and Congressional staff in both houses to explain the problem. Improved language from HR 1732 was rolled into the high profile House energy bill, American Clean Energy and Security Act (ACES), HR 2454.

This language set limits for the color correlated temperature of solid state lighting and specified a more directed efficacy standard called the Targeted Efficacy Rating, which measures only lumens that reach the task area. The ACES bill passed the House on 26 June 2009.

Unfortunately, neither the Senate version of that bill, S 1733, (the Clean Energy and American Power Act) nor S 1462, the American Clean Energy Leadership Act (ACELA), introduced on 16 July, contained this or any language related to outdoor lighting. The gains made with the House passage of HR 2454 did not make the final cut into legislation.

However, at an unusual House/Senate bipartisan press conference held 10 November, members of both parties expressed strong support for an outdoor lighting bill that had been worked out by committee, staff, and industry representatives, with input from the Washington Office. There was no more public action

until 2 March 2010, when S 3059 was introduced by Senator Jeff Bingamon (NM), Chairman of the Senate Energy and Natural Resources Committee. Bill S 3059 incorporates the Targeted Efficacy Rating and sets limits on uplight and glare, depending on efficacy. On 6 May, by a unanimous voice vote, the committee acted to incorporate the wording from S 3059 into the much larger bill, ACELA. The bipartisan support for outdoor lighting language bodes well for future action that will help reduce light pollution. New action may be immanent: stay tuned.

ACELA on outdoor lighting:

Definitions: Certain types of lighting used in outdoor environments are defined as 'covered equipment' under the Energy Policy and Conservation Act, placing them under regulatory authority of the Secretary of Energy. Lower wattage lights, portable lights, amusement park lights, stage lights and other categories are excluded from coverage. This section also defines the Targeted Efficacy Rating as the National Association of Electrical Manufacturers (NEMA) LE—6—2009.

Standards: The bill specifies maximum uplight and glare ratings as well as Targeted Efficacy Ratings for pole mounted outdoor luminaires. Certain types of lighting require a capability to operate at an alternative power level at least 30% below maximum power. This would make it possible to operate the lights at lower wattage during light traffic.

Action: The legislation requires the Secretary of Energy to implement rulemaking procedures and data collection from manufactures to determine whether the standards for pole mounted lighting outlined in the legislation should be amended, and sets a timetable for this review.

Although the bill is far from perfect, IDA has officially supported it because it is a concrete step in the right direction. In Washington, as elsewhere, IDA enjoys widespread recognition as the authority on the nighttime environment. IDA continues to press for more research on the consequences of blue-rich white light, better research on roadway warranting specifications, and other issues.

¹ You can see bill text and much more by visiting www.thomas.gov. Click on "Search by Bill Number," then enter HR 1763, S 3059, etc.

² This issue culminated in IDA's 4 May release of the white paper, "Visibility, Environmental and Astronomical Issues Associated with Blue-Rich White Outdoor Lighting," explained in detail on pgs 8-12.

ANNOUNCING IDA CHAPTERS

A chapter is a local branch of a fraternity or association. That definition fits our excellent Section volunteers to a tee. IDA Sections are so skilled at creating local change and forming dark sky policy that IDA formally announces the promotion of Sections to Chapters. Chapter is a more recognizable term than Section, and it mirrors the structure of other environmental organizations. Beginning at the 2010 Annual General Meeting, the official term for local organized IDA groups in the volunteer handbook and the Web site will become Chapter. Affiliates will remain Affiliates because they do not operate under IDA's non-profit status.

NEW CHAPTERS

IDA Westchester County

Charles Fulco
113 Bowman Ave
Port Chester, NY 10573
+1.914.552.0871
saros61@gmail.com
ms.portchesterschools.org

NEW AFFILIATE

IDA Turkey

Arif Solmaz
Canakkale University Physics Department
Terzioğlu Yeni Campus
Canakkale Centre, TR-17100
(90) 538.614.29.38
arif.solmaz@gmail.com
www.arifsolmaz.wordpress.com

CHAPTER NEWS

CANADIAN CHAPTERS

IDA Quebec

LAST SPRING, IDA Quebec offered a workshop on a draft proposal for outdoor lighting regulation for potential implementation by Quebec municipalities. 98 participants, mostly professionals active in municipal planning and design, attended from within

a 150 km radius of Montreal. Expecting no more than 30 attendees, Quebec Chapter leader Rémi Lacasse was delighted by the interest. The event was repeated in October, garnering 70 participants.

EUROPEAN CHAPTERS

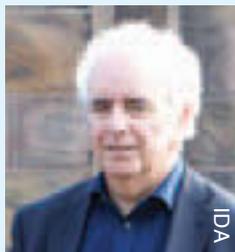
IDA Austria



IDA AUSTRIA HAS launched a dark sky and energy efficiency campaign by visibly promoting good quality lighting for businesses and homes. The seal, “Wir Schützen den Sternhimmel,” or “We’re Protecting the Night Sky” is awarded to locations that are energy efficient and night sky friendly. Günther Wuchterl of the TLS-Tautenburg Observatory and Verein Kuffner-Sternwarte developed the program to raise awareness among the public. The program was announced in Austrian newspapers in May 2010.

EUROPEAN AFFILIATES

Campaign for Dark Skies (UK)



Bob Mizon takes a walking tour of Armagh, Ireland during the 9th Annual European Symposium.

BOB MIZON, COORDINATOR of the United Kingdom's Campaign for Dark Skies (CfDS), was distinguished as a Member of the British Empire (MBE) in the Queen's Birthday Honors list released 12 June 2010 for voluntary service to astronomy and to the environment. The Order of the British Empire is an important national honor.

The Member designation is awarded to citizens for outstanding work for the community.

Light pollution and obtrusive light have been scrutinized in several notable documents from the UK over the past few months, including the Royal Commission on Environmental Pollution's short report on artificial light and the environment and a report on English national parks, with additional attention in the Council of Europe's draft resolution on noise and light nuisance. The CfDS is successfully leveraging these important developments to create real progress toward dark sky protection.

U.S. CHAPTERS

IDA Northeast

IDA NORTHEAST LEADER Leo Smith scored a huge victory for dark skies when the states of Connecticut and New Hampshire adopted midnight curfews for streetlights. Curfews significantly reduce light at night, but they can be tricky to achieve. Municipalities interested in curfews have little financial incentive because the utility company may present streetlight rates as a package of “dusk to dawn” service. But a special rate for part-night streetlights can be achieved!

In 2007, Mr. Smith filed a Motion to Intervene with the Department of Public Utility Control (DPUC) for streetlights when the state utility company filed for a rate increase. DPUC granted the motion, which introduced the idea of a new rate for streetlights that turn off at midnight. In 2008, the utility company was ordered to present a reduced rate for part-night streetlights at the time of its next rate increase.

A financial incentive for a streetlight curfew promotes dark sky interests and saves significant energy, not to mention tax dollars. Many municipalities see the practicality of a midnight rate for streetlights. Following Connecticut's lead, New Hampshire passed a law in July 2009 requiring the utility regulators to develop a new rate for part-night streetlights.

continued on page 14

One Planet One Star at a Time

“It is possible to recover the magnificence of the starry night sky to once again inspire and nurture the hearts and souls of all children of this planet.”

LAUNCHED DURING GLOBAL Astronomy Month 2010, the One Star at a Time program is a worldwide effort to create accessible public spaces to view a starry night sky. Co-chaired by IDA Board member Audrey Fischer and Cipriano Marin, coordinator of the Starlight Initiative and Secretary General of the UNESCO Center of the Canary Islands, the program uses night sky conservation to unite people across the planet as part of the international astronomy collective Astronomers Without Borders (AWB). One Star will engage the average citizen to cherish and protect the night sky through personal pledges and registration of public stargazing areas called StarParks.



AS A DELEGATE of the Chicago 2016 Olympics Conservation Summit of Sport & Sustainability, Ms. Fischer had the opportunity to question former British Prime Minister Tony Blair about the responsibility for protecting the natural night. She was inspired by his response that the night's disappearance first needed to become the concern of the citizen, then required the support of civic and public leaders and widespread grassroots cooperation. She began to formulate a project that would raise awareness of light pollution by creating communal

spaces to discover the night sky. Meanwhile, Mike Simmons, founder of AWB, noticed that night sky conservation is a growing goal of AWB members across the globe. He invited Fischer to head a new light pollution division for the organization. One Star was born.

True to AWB's message of “One People, One Sky,” the One Star program strives to reinforce the idea that a starry night sky is a resource shared by all. StarParks created through One Star are hoped to provide a space for international interaction at a young age, thus creating a space to encourage tolerance, respect and appreciation of diverse backgrounds.

Fischer intends to develop a “Virtual Star Camp” program where kids in StarParks in many countries can study the night skies simultaneously in 30-minute sessions led by international mentors. Activities would range from sketching astral objects to eclipse commentary, astrophotography via robotic scopes, and Webcast tours of the cosmos. “If kids can first have reason to look up to see the stars... and then be introduced to the magnificent new discoveries of the cosmos, it can be exciting and bonding to explore and learn with other kids from around the world,” Fischer explains.



Audrey Fischer displays One Star artwork by elephant Boon Mee with his mahout (elephant handler), Thongsri Lohhapoam, in Thailand.

One Star is built on grassroots participation. Anyone can join in one of three ways.

1. Take the pledge. Pledge to preserve and protect the night sky above your observing spot, home, or business by doing what you can on a practical level to reduce light pollution within your own domain. Shield all outdoor lighting, install dimmers, and encourage friends and neighbors to do the same.

2. Register a StarPark in your community. A StarPark is an oasis within a community where thoughtful lighting practices permit the best public viewing of the night sky in the area. Due to the vast disparity in sky quality between urban and rural sites, there is no defined maximum level of allowable light. StarParks can exist anywhere and be as small as a rooftop or as large as a state park. The only criteria are community accessibility and public sky viewing opportunities. StarPark stewardship can fall to an individual or a group. Registered StarParks will become a part of the StarPark Network and will receive a downloadable, numbered certificate and access to artwork for suggested StarPark signage.

3. Spread the word. Organize a pledge and registration drive at a star party or speak to clubs in your area. Training and materials are free at the One Star Web site, www.onestar-awb.org

This ongoing campaign hopes to designate a StarPark in every community in the world. Large and small, these nighttime sanctuaries are meant to become places for children and families to gather and learn. Formation of a StarPark Network fuses isolated conservation efforts into a chain of international oases for astronomy-related activities. Ms. Fischer believes that registering these sites across the world creates a unique commonality and opens a gateway to international communication: “Light pollution is a global issue, best solved on a global scale. We can best respond locally when energized globally.”

Seeing Blue

POORLY DESIGNED OUTDOOR lighting is one of the most conspicuous forms of energy waste. The global call to conserve energy resources has cities scrambling to replace public lighting with brand new systems. In the U.S., changes are further spurred by federal economic stimulus funding. Technology under development for decades has produced a number of options, many with a potential for energy savings. Of these, high brightness white light emitting diodes (LEDs) have emerged as an industry favorite.

Many of these new options have never been applied on a broad scale, and may have unexpected consequences if widely used for outdoor lighting. In particular, the stronger blue emission produced by white light sources, such as LEDs, has been shown to have increased negative effects on astronomy and sky glow, and has a greater impact on animal behavior and circadian rhythms than other types of light. Widespread installation of white light sources rich in blue emission is among the largest concerns of the dark sky movement.

Lamp choices made today will affect night lighting for decades, maybe longer. It is imperative that decision makers understand the consequences—both positive and negative—of lighting choices. On 4 May 2010, IDA released a comprehensive review paper titled *Visibility, Environmental, and Astronomical Issues Associated with Blue-Rich White Outdoor Lighting*, to raise awareness of likely or potential negative consequences of blue-rich white light (BRWL) and to help governments and the industry balance these consequences against the more widely touted benefits.

This article provides an introduction to the controversy surrounding BRWL. To fully understand the problems, we must first understand its properties.

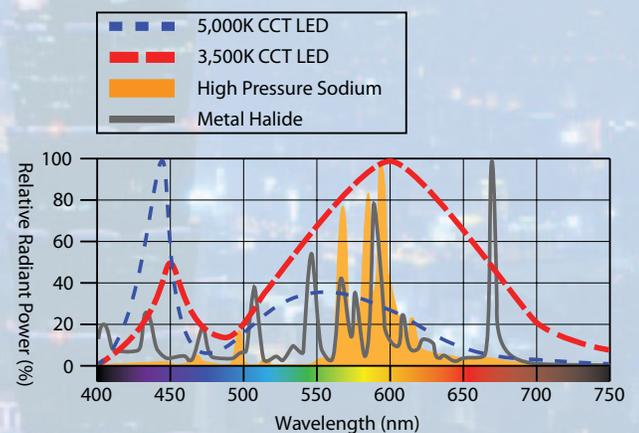
Spectral power

Beauty may be in the eye of the beholder, but the eye relies upon light. Light visible to humans has wavelengths from about 380 to 760 nanometers (nm), with longer wavelengths appearing red and shorter wavelengths appearing blue and violet.

Different lamps have different spectra: a lamp's spectral power distribution is a quantitative measure of the amount of energy (or power) emitted at different wavelengths. The broad spectral characteristics of different lamps are often discernible to the naked eye. "Warm white" sources that emit more strongly at the middle and longer (red) wavelengths, such as incandescent bulbs, are often aesthetically preferred. "Cool white" sources with a spectral power distribution favoring short wavelengths cast a light that appears harsher and colder to many observers when used for artificial lighting, even though it may approximate the color of daylight.

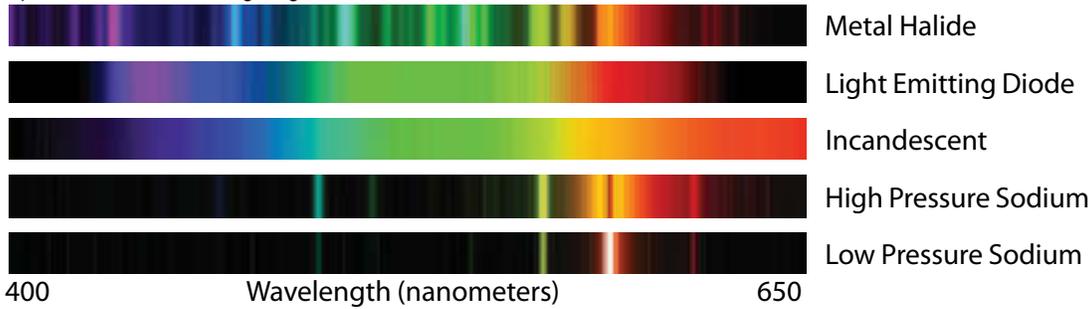
Much of the recent interest in BRWL sources stems from two factors. The first is the rapid improvement in the efficiency of white LED lighting. LEDs promise to soon surpass current lighting technologies in the ability to produce light for less energy. Further, LEDs produce light in a way that can be more effectively controlled, increasing efficiency of fixtures and allowing light to be delivered precisely to the areas where and when it is needed.

The second factor is more complex, and more controversial. LEDs can be made in nearly every visible color, but the most efficient formulations are rich in blue light, because blue wavelengths activate phosphors which provide the other colors necessary for high quality white light.



Warm white LEDs under 3,500K CCT emit a smaller fraction of their energy in the blue portion of the spectrum.

Spectra of five common lighting sources



Dark-adapted (nighttime) eyes are more sensitive to shorter (bluer) wavelengths than light adapted (daytime) eyes. Therefore, all else being equal, a light source producing more blue light will tend to appear brighter to the dark-adapted eye. Some lighting researchers have proposed “correction” factors that allocate extra lumens (a measure of visible light output) to cool-white sources. This leads to an apparent additional increase in efficiency for blue-rich white LEDs. Those with more blue emissions—called *high Correlated Color Temperature (CCT) LEDs*—benefit the most from this correction. The controversy arises, however, because under night lighting conditions the eyes are not fully dark-adapted. Instead, under typical outdoor environments illuminated by artificial lighting, our eyes have a mixed visual response, with a complex and only partly understood combination of the characteristics of light-adapted and dark-adapted vision (from the eye’s cone cells and rod cells respectively). This means that the benefits of BRWL sources in the real world are usually less, often much less, than predicted by the simple correction factors that have been proposed to explain response under laboratory conditions. In other words, much of the benefit of BRWL sources is only realized when illumination is much fainter than commonly encountered in artificially illuminated outdoor environments and when the distribution of light is tailored to take advantage of the eye’s response.

Research in visual, environmental, and health sciences indicates that our understanding of the effects of light at night, in particular BRWL, lags behind the development and use of lighting technologies. From a historical perspective, increases in lamp efficiency have not yielded expected savings, as such technological advancements were often utilized to apply more light, light areas and tasks that were not previously lighted, or otherwise not matched by changes to lighting practices that leveraged these technological advancements. The current initiative to create the most energy efficient lamp technology threatens to disappoint those who look to LEDs and other BRWL sources as a technological salvation. Furthermore, such light carries a greater impact to the dark nighttime environment and may have unintended consequences for human vision and health.

The IDA white paper

In October 2009, IDA convened a panel of 16 experts in Tucson, Arizona to evaluate concerns about BRWL. The group produced a press release on 10 October 2009 and initiated work on a com-

prehensive paper reviewing the issues. A draft white paper was released to a select audience in February 2010. In the months that followed, the BRWL draft white paper received dozens of comments as part of a formal review. After constructive feedback, refining and expanding the research, and substantive changes to the text, the endeavor grew into a comprehensive review of BRWL in a number of contexts. It was released on 4 May 2010 as a white paper entitled *Visibility, Environmental, and Astronomical Issues Associated with Blue-Rich White Outdoor Lighting*.

The paper documents the effects of BRWL and examines existing research to define what is and is not known about the benefits and limitations of BRWL. The review of current knowledge illuminates specific concerns about the impacts of BRWL on the nighttime environment, as well as gaps in research, that suggest directions for future studies. It will be used as a basis for official IDA recommendations and position statements, and has been offered as a resource to the lighting industry. It is the intention of IDA to assist government and industry officials in gaining full knowledge of the impact of BRWL on vision, ecosystems, and the nighttime environment, thus enabling these bodies to avoid pitfalls that may otherwise undermine the transition to a very promising new technology.

Known effects of blue-rich white light

BRWL sources are popular options wherever LED streetlights are installed. Cities or municipalities considering changes to their public lighting would benefit from increased awareness of these lamps’ potential effects. Members and advocates are encouraged to disseminate this research. Findings are summarized below. The full white paper is available for download on the IDA Web site, www.darksky.org

Visibility

Most illumination levels at night engage mesopic vision, which is comprised of both photopic (high light level vision using cones) and scotopic (low light level vision using rods) function. There is currently no universally applicable metric to define or measure mesopic function, as the eye-brain system blends the two realms of vision in complex ways. Several efforts to articulate how such mesopic vision works have been proposed; perhaps the most developed system is the one proposed by the International Commission on Illumination (CIE) (described in TC 1-58). Many age-, time-, and illumination-level-variable visual functions are of concern when



This test street in Anchorage, Alaska, USA compares the quality of light from warm, low CCT LEDs (right foreground), high pressure sodium vapor (left middle) and cool, high CCT LEDs (right background). The residents of this street preferred the warm LEDs in the foreground.

glaring than conventional halogen headlights. A light source with increased spectral output below 500 nm will increase the perception of glare, particularly for older people, and is more likely to hinder vision than a conventional source of the same intensity.

Adaptation and the aging eye

Several studies indicate that blue light reduces pupil size more than other types of light, especially at lower lighting levels. Blue light also increases the time it takes for the eye to adapt to darkness or low-level lighting.

As the eye ages, it requires more light and greater contrast to see well. The lens yellows and becomes less transparent with time, and yellowed lenses absorb more blue light; thus, less total light reaches the retina of older people, especially when BRWL sources are used. In addition, older pupils are in general more constricted, increasing the amount of time it takes to adjust to different light levels. BRWL contributes to slowing these adaptation processes.

designing outdoor lighting, including utility, detection of objects (in both central and peripheral vision), identification, adaptation, and aesthetics. The interrelation of all of these with lamp spectral power distribution is poorly understood outside of controlled laboratory experiments. The premature adoption of a mesopic system would substantially skew the engineering metrics used to define lamp efficiency while not capturing the true utility of such light for human needs.

Glare

Glare reduction is a critical design aspect for all outdoor lighting installations and lamp types. Research done as early as 1955 indicates that BRWL causes more glare, with later studies confirming a wavelength of approximately 420 nm to be most closely linked with discomfort glare. It has been widely observed that BRWL headlights on automobiles are perceived as more

Atmospheric scatter and sky glow

Increased scattering from BRWL sources leads to 15% to 20% more sky glow detectable by an astronomical instrument than high-pressure sodium (HPS) or low-pressure sodium (LPS). Due to the eye's increased sensitivity to blue light at lower levels, the visual brightness of sky glow produced by BRWL can appear three to five times brighter than it appears with HPS and up to 15 times as bright when compared to LPS.

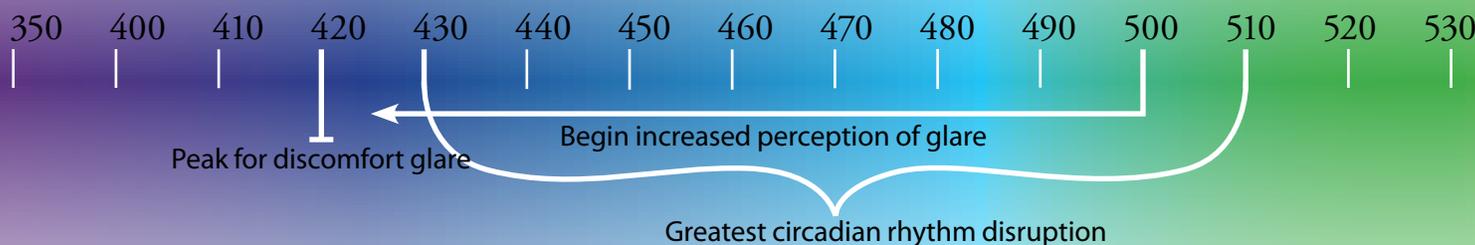
BRWL contributes to sky glow in a portion of the spectrum that currently suffers little artificial sky glow. Further, under natural conditions the brightness of the sky in the blue portion of the spectrum



Blue-rich artificial light



Recommended wavelength range for minimizing adverse effects of blue light on sky quality



is lower. In other words, BRWL introduces a different type of light pollution, to a part of the spectrum that is relatively dark and relatively less polluted. Thus, widespread use of BRWL will substantially increase the degradation of visual and astronomical sky quality.

Ecological considerations

Artificial light in the environment must be considered a chronic impairment of habitat. However, while there is evidence that artificial light affects species behavior, diet, movement, and mating, the relationship between artificial light and wildlife has rarely received the level of study that definitively answers questions about spectrum and illumination threshold.

While no absolute conclusions have been drawn, previous research suggests BRWL heightens response in certain species. Loggerhead sea turtles are ten times more likely to be attracted to light at 450 nm than 600 nm, with four Atlantic sea turtle species showing a similar spectral misorientation response. Light sources that have a strong blue and ultraviolet component are particularly attractive to insects, though broad spectrum sources are known to attract insects as well. Changes in insect behavior often affect numerous other species that prey on insects, including amphibians and bats. Additionally, the circadian response of wildlife often resembles that of humans; thus even if a species exhibits no behavioral or orientation response to BRWL, such light may be altering the diurnal and nocturnal patterns of wildlife.

Evidence does not indicate that the behavior of all species is altered by short-wavelength light. Some birds have exhibited a stronger attraction to red light, while others avoid it. It is because of these discrepancies and interspecies behavioral unpredictability that IDA advocates for comprehensive studies that investigate spectral effects to be performed before radically different light sources are widely introduced into nocturnal ecosystems.

Circadian disruption

Light inhibits secretion of the hormone melatonin.



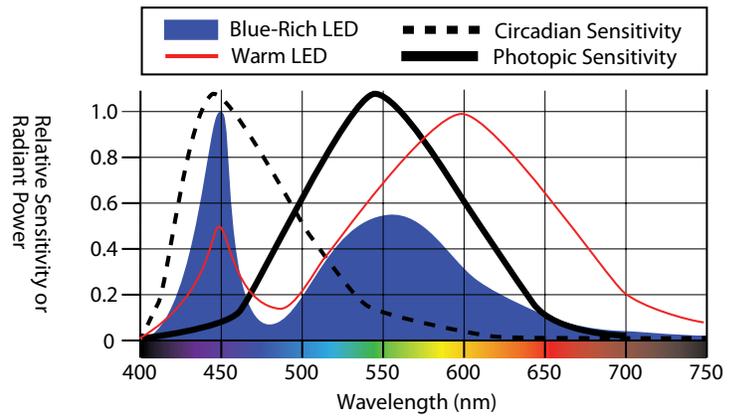
High Pressure Sodium Lights

Low Pressure Sodium Lights

540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690

Peak sensitivity for photopic vision

Wavelength of LPS and narrow-spectrum amber LEDs, ideal for areas close to observatories and sea turtle nesting beaches



Human photopic and circadian sensitivity curves displayed against a typical blue-rich and warm white LED spectrum.

tonin. Blue light between 430 and 510 nm shows the greatest disruption of circadian rhythm and melatonin secretion, with peak sensitivity around 460 nm. Melatonin levels dictate circadian cycles and play a role in immune system function of animals and humans. Studies have effectively linked low melatonin production with the growth of some human cancers, notably breast cancer. Some studies suggest that the illumination threshold for melatonin disruption is quite low, but no exact amounts have been found. All potential compounding factors have not been ruled out, and crucial research concerning realistic incidental exposure to outdoor lighting, as well as the spectral characteristics of such lighting, has not been published. However, the effects of blue light on melatonin production, and the effects of melatonin on human cancer growth in certain laboratory experiments, are uncontroversial. While a firm connection between outdoor lighting and cancer has not yet been established, if true it is clear that the blue component of such light would be a greater risk factor.

Less than two weeks after IDA published this white paper, the Rensselaer Polytechnic Institute's Lighting Research Center released the study *The Potential of Outdoor Lighting for Stimulating the Human Circadian System*. The study expresses skepticism of claims that BRWL can affect circadian rhythm to the point of serious harm, yet shows that exposure to 6,500K CCT light

at streetlight lighting levels for just one hour is expected to show measurable effects on human melatonin production. Its statement that "...continued investigations of light-induced disruption of the human circadian system are clearly warranted" corroborates IDA's assertion that further testing is necessary before the widespread introduction of new BRWL technologies. While IDA clearly does not want to raise undue alarm or over-generalize the connection between human health and artificial light, the widespread adoption of BRWL sources and the number of people potentially affected result in a risk factor that must be acknowledged by engineering, environmental and human health professionals.

A unified approach

Thomas Edison quipped that he had to first learn 1,000 ways to not build a light bulb before he learned how to build one. With each attempt, he drew upon his wide-ranging intellect, his concern for his fellow man, and his fortitude for hard work. His efforts resulted in the first viable electric lamp 130 years ago. Today we are still "always finding a better way" to use electric lighting, particularly outdoors.

The question before us now is far deeper and wider than what is the optimal technology for producing light. Though cultural tastes, government initiatives, short-term economics, and environmental ethics may dictate market fads, professional lighting engineers recognize that the best light is one that balances a range of needs and concerns. Objective, professional research is needed to provide manufacturers with data needed to minimize light pollution while considering other variables. A light source, fixture, or design that optimizes only one aspect will likely fail miserably when introduced in a wider context. Sustainable lighting must cross multiple realms—technical, environmental, and socioeconomic. The IDA encourages such a holistic approach, and will continue to ensure that the environmental, cultural, social, and civic aspects of protecting dark skies and the nighttime environment are collectively addressed by the lighting industry, government, and community leaders.

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Technical editing by Christian Luginbuhl, Chadwick Moore and Terry McGowan

What do we do now?

Cities ready to make immediate changes to their outdoor lighting may not have time to wait for results of extensive testing of new light sources. IDA offers the following suggestions for communities currently planning lighting retrofits using LEDs:

Always choose fully shielded fixtures that emit no light upward.

Use "warm-white" or filtered LEDs (CCT lower than about 3,000K) to minimize blue emission.

Look for products with dimming capabilities; consider dimming or turning off the lights at late hours.

Work with utility companies to establish a reduced rate for dimmed or part-time lighting.

Consider the longevity of the entire fixture over the longevity of the light source alone. Power supply or conduit failure will require fixture maintenance even if there is nothing wrong with the lamp itself.

The future of light?

SOLID STATE LIGHTING has the potential to revolutionize outdoor lighting in a profoundly positive way. LED lighting in particular can be fine tuned to decrease most negative impact on the night environment. Their directionality and controllability opens the door to energy saving innovations and facilitates the large scale implementation of automatic timers, dimmers, and sensors. LED efficiency and longevity may provide a real contribution to the world's lighting needs.

Right now, the variance and speed in LED product development is nothing short of astounding. Basic SSL technology has advanced to the point where a broad range of finely tuned and radically different LED applications are appearing more or less continuously on the market.

If developers concentrate on creating high efficacy lamps rich in warm hues, LED technology could become an outstanding source for energy efficient, night sky friendly outdoor lighting. Already, some LED developers are creating a highly efficient product with a spectral power distribution (SPD) that avoids peaks in any wavelength. Driven by an indicated aesthetic preference for warm-toned hues, these manufacturers are developing high efficacy commercial LED products with significantly reduced blue spectrum emissions. Philips Lumileds, Osram, and Seoul Semiconductor have created notably broad spectrum light sources at efficiencies that are among the industry's best, and tout a significantly increased Color Rendition Index. Cree is developing a product that emits less blue light than some conventional High Intensity Discharge lamps used today. If development continues to advance in this way, dark sky advocates and industry leaders will soon have a number of eminently usable LED products for residential, commercial, and public application.

However, warm white LED technology cannot by itself provide the answer to the world's outdoor lighting needs without the continual application of sensible lighting principles and practices. While lamp efficiency and consideration of SPD are significant accomplishments, true night sky friendly lighting can still only be achieved by vigilant examination of how much light actually needs to be used and routine implementation of minimum levels required for security and recreation. LED innovations represent an important tool in the dark skies movement, but we must be sure to wield it wisely.

LIGHTING NEWS

INCREASED INTERNATIONAL ATTENTION on light pollution has led to worldwide recognition of the Fixture Seal of Approval. IDA is proud to feature products from Italy and Slovenia, two European leaders in dark sky protection. FSA is also happy to include dark sky innovations and accessories.

DITO



DITO's DPS MODEL line is particularly suited for illumination of alleys, drive-ways, pedestrian pavements, parking facilities and gardens. The DPS model line features built-in PWM dimming control. Up to 100 lamps can be controlled with one cost-effective DITO DLS-1 control unit. The lamp produces natural white light. www.dito-lighting.com

Grah Automotive

AFTER MANY YEARS of successful production of lights for the car industry, Slovenia's Grah Automotive expanded its activity to LED lights for general use. Grah's external LED lighting led to a revolution in the European market with technologically advanced and patented outdoor LED street lighting for a price typical of conventional lighting. www.grah-automotive.si



iGuzzini



IGUZZINI WAS ESTABLISHED in 1958 and today produces indoor and outdoor lighting fixtures. It is the Italian leader in technical and architectural lighting and ranks amongst the leading companies worldwide. It belongs to Fimag, a holding company that includes the companies of the Guzzini Group, including Fratelli Guzzini,

iGuzzini and Teuco.

<http://www.iguzzini.com/html/en/index.html>

Intense Lighting

INTENSE LIGHTING'S NEW V-Rail is a linear HB-LED Luminaire. Designed to illuminate stairways, ramps and paths of egress and also performs as a hand-rail or guardrail. Capable of delivering uniform light at an excess of 10 foot-candles on the path. V-Rail is UL Wet Location Listed and is certified by the International Dark-Sky Association. <http://www.intenselighting.com/vrail.php>



The MLO nears the finish line...REALLY!

SINCE THE FOUNDING of IDA, an integral part of its mission has been to promote community outdoor lighting standards. We have worked for many years to develop a model lighting ordinance (MLO) that is comprehensive, yet easily understood by the layperson. Many commented during the first public review that the MLO fell short on ease of use. We listened, and the next draft of the MLO is complete and navigable.

The new draft, available for public review this summer, includes a user's guide that explains in plain English how to develop a comprehensive and enforceable outdoor lighting ordinance. The user's guide will make the new MLO accessible to most planning staff and elected officials.

In conjunction with the release of the MLO, IDA will offer a series of regional training sessions. We will kick off this effort with an introduction to the MLO on 26 June 2010, just prior to our Annual General Meeting in Tucson, Arizona. Members of the MLO Task Force will discuss the details of the MLO, followed by a question and answer period. Topics that will be spotlighted include the new BUG rating system for luminaires and working with planning officials to get the ordinance process started.

Dollar General retrofit goes national



Jim Reeves

Before and after shots of Dollar General show enormous improvements in lighting.



Jim Reeves

WHEN A DOLLAR General store opened in Clayton, Georgia, its egregious nighttime lighting reminded Jim Reeves, leader of Dark Sky North Georgia, of the mother ship from the movie *Close Encounters*. Reeves immediately contacted corporate headquarters, and the store made some changes to their outdoor lighting based on that initial contact. Reeves saw room for further improvement and continued his dialogue with Dollar General. After a few months of correspondence, the Dollar General in Clayton took out fixtures, switched bulbs, and added timers that turn lights off after midnight. Elated, Reeves wrote letters to

two regional papers praising the improvements. Due to his sound advice and diplomacy, Reeves has been contacted by a construction engineer at Dollar General corporate headquarters for advice on new lighting guidelines for all 4,300 national stores!

continued from page 6

IDA Northwest

DAVE INGRAM WILL provide comments to the Washington State Building Code Council in June as he continues to work for passage of the statewide building code, House Bill 1069.

IDA Pennsylvania

THE PENNSYLVANIA OUTDOOR Lighting Council conducted its eleventh lighting workshop for municipal officials, this one for Lebanon and Dauphin Counties. Topics included outdoor lighting basics, how to identify good and bad lighting, legal, safety, and security implications and how to enact and enforce an effective lighting ordinance.

IDA Wisconsin

BEFORE LEAVING FOR Alpine, Texas, Wisconsin Chapter leader Dave Oesper has been working to ensure that new cellular towers are equipped with only red strobe lights at night in an attempt to minimize impact on migrating birds.

TRANSITIONS

Carolyn Elizabeth Gregory

CAROLYN ELIZABETH GREGORY, widow of John Gregory, passed away on 11 February 2010 after a valiant, three-month-long effort to recover from the injuries she received in the tragic car accident that took her husband's life. Mrs. Gregory was a celebrated teacher and musical performer. She was also a cheerleader for John's many dark sky efforts. She was a loving partner who delighted in co-hosting or attending star parties with John. Carolyn and John Gregory will be remembered fondly by many who encountered them at astronomy events all over the world.

Thanks to Cindy Luongo Cassidy of Green Earth Lighting LLC, for information on Carolyn Gregory and for donating a reflector (shield) in memory of John Gregory to cover the area light at the Hays County Citizens Collection Station in Driftwood, Texas.

BOOK REVIEW

Stars Above, Earth Below: A Guide to Astronomy in the National Parks

Book by Tyler Nordgren
Review by Rowena Davis

©2010, Springer Publishing
ISBN: 978-1-4419-1648-8

MORE THAN A “guide to astronomy,” *Stars Above, Earth Below* is a journey through Earth and space. It begins in the majestic contours of Yosemite National Park, where Nordgren describes the features of the Milky Way with as much dimensionality as the landscape stretching underfoot. After mapping the properties of the stars of the Summer Triangle, the reader clammers over nebulae and stares deep into ravines of galactic dust. In a friendly discourse reminiscent of a park ranger, the night sky is revealed with an immediacy and vibrancy created by linking sky happenings to terrestrial events. The lessons continue in national parks across the U.S., where celestial extremes are mirrored by equally captivating phenomena here on Earth.

This book makes astronomy accessible and fun. Colorful photographs, vivid descriptions of sky objects, and illustrations of constellations and sky movement will entice the novice. A list of suggested observations for binoculars or telescope and star charts at the end of every chapter promise to reveal the night's hidden gems. Yet it is a scientific book that contains enough technical discussion to appeal to the serious amateur. It can be picked up by any naturalist as well. Nordgren's obvious reverence for both astronomical and geologic activity spark a renewed interest in the Earth underfoot while exploring our place in the Universe.

National parks are valued not only for their physical elements; they are vital cultural resources. *Stars Above* immerses the reader in night lore and intersperses hard science with folktales and history. Each chapter strolls through the scientific elements of Earth and sky, often veering for a history lesson or pausing for an offhand remark. Readers who may be distracted by the meandering prose may wish to remember that the best walks in the woods contain a few detours. How could an adventure through the galaxy offer less?

Q & A with Tyler Nordgren

Dr. Tyler Nordgren is an astronomer and an associate professor of physics at the University of Redlands in California. For twelve months he worked with the National Park Service, speaking on astronomy and light pollution as he visited parks around the U.S. His presentation at the 2010 ACon Expo explains how geology and culture can help protect dark sky sites.

Why did you write this book?

WE NEED TO give people a reason to cherish the night sky. I wanted to reach beyond amateur astronomers, beyond folks who already knew they loved the sky. My target audience is the family in a national park, a mom, pop, and a kid in a Winnebago. At night, they look up and see more stars than they ever have in their lives. They want to know more about it.

A lot of people will be reading this in their house, thinking about where they want to go, so I include a lot of descriptions of where I am and what I'm seeing. But I also include hard astronomical and geological facts, to offer something about the science behind these amazing views and places.

I teach an Astronomy 101 class at the University of Redlands, and I learned a lot from my students about how to make astronomy accessible. I tried to frame the book in a way that is tangible, directly relevant to the lives of people who visit the parks. Many wonderful astronomy books do a great job explaining string theory, but I wanted to make astronomy personal, invite people into it. That meant focusing on what people can see, so they can live it for themselves.

Your last chapter covers light pollution and the efforts of the National Parks Night Sky Team. How did they help shape the book?

I HAPPENED TO attend a talk given by a Night Sky Team ranger at Yosemite. The people sitting next to me weren't astronomers, they were park-goers looking for something to do. But around me I could see their interest as suddenly they had their universe expanded. Then the crowd learned about how fortunate they were to have these skies, with a quality they'd never experienced at home, and how valuable it was to protect them. I realized that this program, the star talks and the conservation, was helping me continue to be an astronomer. People were seeing and responding to what they saw. It was the ultimate outreach.

Why does so much of the book cover culture, not just focus on astronomy?

AS A KID I always loved science. Then I read Carl Sagan's book *Cosmos*, and it put all this science into a context of art

and philosophy and history. It struck me then that one of the most profoundly human endeavors was to be a scientist. *Stars Above* tries to reflect this concept, that science is deeply ingrained in our very culture and history. I wanted to show how these all tie together.

You discuss a lot of moons and planets. Why do they play such a prominent role?

THE COMMUNITY OF discovered planets is getting larger by the day. We are now aware of over 300 of these fascinating cosmic objects, so much closer than stars. But by far the closest to us is Earth, which is just as much of a cosmic object as distant planets, and shares many of their properties. I wanted to show all the ways it's similar to other worlds, other moons. It shares this kinship.

At the same time, Earth is the only planet we have found that supports life. I also want people to realize how different we are. Maybe if people can understand how special this planet is we'll be inspired to take better care of it.

Any unexpected lessons as you wrote this book?

AS AN ASTRONOMER I'd been to darkish places, but never to truly dark sites, and they took my breath away. To be able to sit up and look around, to see the entire landscape lit up by the ancient light of thousands of stars, to see my world illuminated by the galaxy itself, is indescribable.

It takes patience. If you are someplace truly dark, you have to have the patience to truly let your eyes spend that hour adapting, not realizing what payoff you're going to get when it's over. Lie back and relax. When you let life slow down a little, the universe will open up.

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Author Tyler Nordgren watches the summer Milky Way rise as the moon sets over Yosemite National Park in California, USA.

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