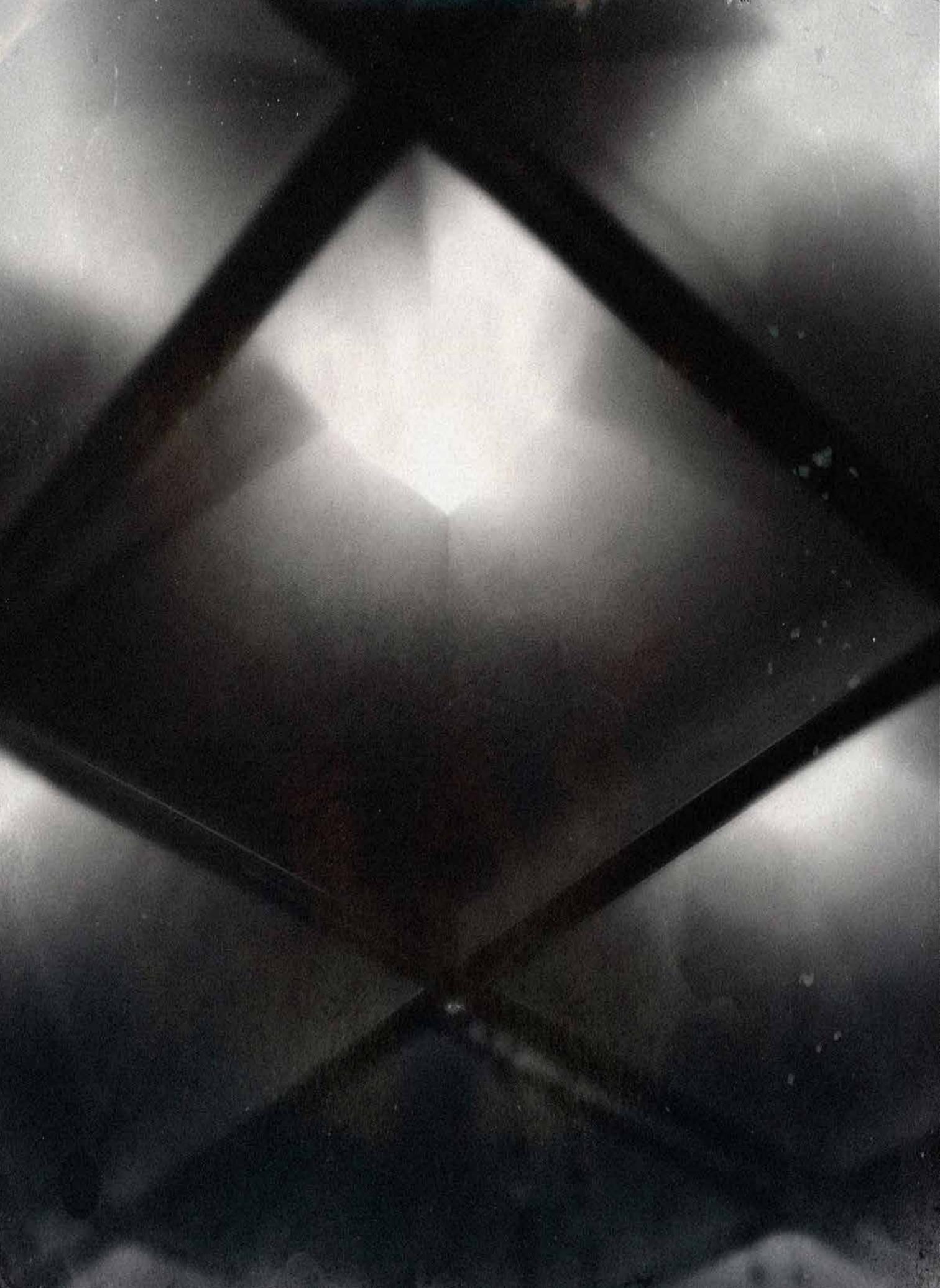


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DAYLIGHT & ARCHITECTURE MAGAZINE BY  
VELUX GROUP SPRING 2016 ISSUE 25 10 EURO  
NIGHT TOWARDS DAY





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# NIGHT TOWARDS DAY

The natural light from the night sky is almost impossible for most of us to see or even to imagine: the stars spread shimmering above, the low pulse of a reddish moon setting in the west, stars from one horizon to the other, dancing white with shades of orange and blue, and green and gold.

What natural light experiences and exposure do people need in order to live? And how do we consider and cope with darkness at night? These are key questions in this issue of Daylight/Architecture Magazine, which celebrates natural light in its 25th edition as the VELUX Group celebrates its 75th anniversary of bringing light to life. In 1941, the founder of the VELUX Group, Villum Kann Rasmussen, came up with the idea of transforming dark attics into living spaces with daylight and fresh air. Since then, it has been our fundamental mission to improve the way we all live in our homes, the way our children thrive at school and the way light and ventilation are integrated in our workplaces.

How do we engage, experience and thrive on daylight, moonlight and starlight in the buildings in which we live, work and play? Living in a 24-hour society, we modern human beings can turn night into day, and vice versa, by illuminating the night and pushing daylight out of indoor spaces. We spend 90% of our time in buildings – this affects our health, our social life – and the earth's ecosystems,

Standing outside on a dark night and gazing at myriads of stars has become a rare event today. Light pollution – the man-made sky glow above the urbanised areas of the world – is blinding our eyes to the magic of natural moonlight and starlight, as the American writer Paul Bogard explains in this issue. More than half the people living in Europe and North America cannot even see the Milky Way from where they live.

The consequences for ecosystems are severe: animals – bats, migrant birds, even fish – are affected by our culture that 'turns night into day'. So are human sleep patterns, as the American historian, A. Roger Ekirch, has found out. In his article, he explains how human sleep has become compressed to a point where many of us are now facing health problems due to insomnia.

It is time to rediscover the magic of the night. Architecture can play a significant role in this effort, serving as a tool for perception and engagement with our physical surroundings. Buildings are experienced differently through natural light by day and by night and, in particular, at twilight – the transition from night to day. We asked two photographers, Adam Mørk and Daniel Blaufuks, to explore four buildings, each of which has a unique relationship to the natural light entering it. Roof windows and skylights are important providers of the daylight and moonlight that enlighten our lives around the clock. The unique photographs show that natural light is always around us, even in places that we would normally consider dark.

This issue of Daylight/Architecture celebrates natural light – prioritising better living environments for people and our earth's ecosystems with daylight, twilight and moonlight.

Wishing you an enlightening read – and plenty of "starry, starry nights".

The VELUX Group



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### THE NIGHT SIDE OF LIFE

Human beings need the natural rhythms of light and dark to maintain a stable sleep/wake rhythm. Many other species, too, rely on dark nights and the dim light of the stars for orientation, search of food, and important cues about the time of year and day. This article highlights some of the natural wonders of the night – and shows what is at stake with the increasing proliferation of man-made light.

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### THE MAGIC OF THE NIGHT

The view of the night sky is an inexhaustible source of inspiration; it has led poets and scientists, painters and everyday people to reflect on what it means to be human. Yet this sight has become rare in our time. "Too often, we in cities forget that night is half our life, half the day, half the world," writes Paul Bogard in his article. He argues for a new culture of lighting design that is grounded in an appreciation of natural light both at day and during the night.

## 56

### NIGHT, WHAT ART THOU GOOD FOR?

Around the turn of the 21st century, a 'nonstop culture' is increasingly spreading across the globe. The historian Röger Ekirch explains how it developed and looks back to a time when European societies lived largely without artificial light. His article provides an account of the surprisingly rich night life in former centuries and explains how well people were equipped to navigate the night with the help of the moon and the stars alone.

## 74

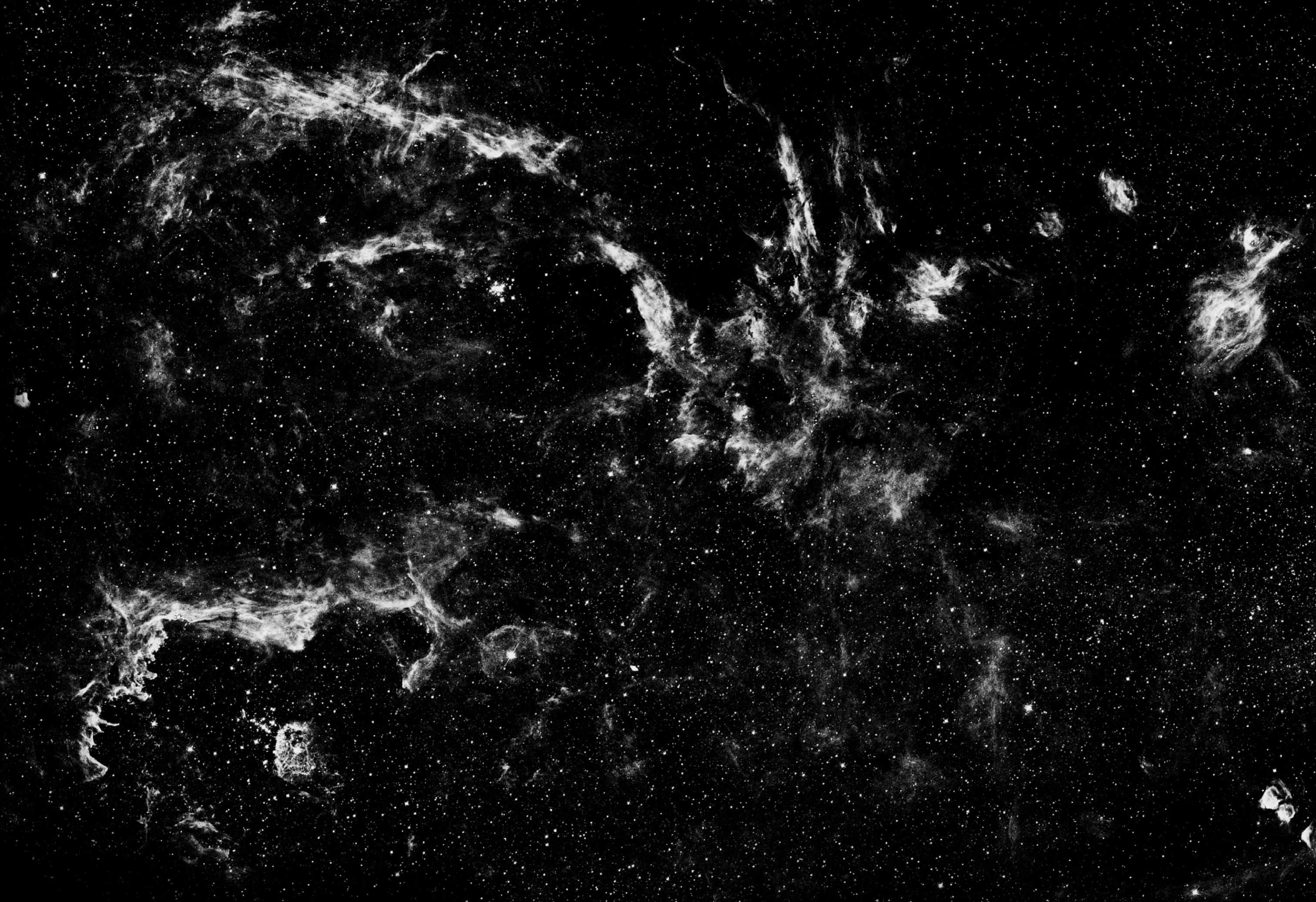
### NIGHT AND SLEEP – A BRIEF OVERVIEW

Why do we sleep? What happens if we don't? How do human sleeping patterns vary with sex and age? How does light at night, and a variety of social factors, influence sleep patterns? Answers are provided in this collection of facts and graphics about the "golden chain that ties health and our bodies together," as the British poet Thomas Decker once called human sleep.

## 22 31 36 47

### SEEING LIGHT – UNDERSTANDING LIFE

Even in urban environments, natural phenomena are all around us: the fresh morning breeze, rain running down a window pane, sunlight reflected on a roof or the full moon in the night sky. How can architecture sharpen our senses to these phenomena? And what will be the consequences for our apprehension of nature and for our self-consciousness? Inspired by these questions, the photographers Adam Mørk and Daniel Blaufuks visited four buildings in Denmark and Austria at different times of night and day, tracing the natural light in and around them and exploring the atmospheres that it creates.





# THE MAGIC OF THE NIGHT

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When viewing the night sky, most of us feel an intimate connection to the universe. Yet starry skies and moonlit nights have become increasingly rare for city-dwellers today. Given the harm that too much light at night is inflicting on human beings and ecosystems, it is time to reconsider our relationship to the 'nocturnal side' of our lives and our culture.

By Paul Bogard

*"If the stars should appear one night in a thousand years, how would men believe and adore; and preserve for many generations the remembrance of the city of God which had been shown!"*  
– Ralph Waldo Emerson (1836)

The sight is almost impossible now for most of us to imagine: the natural lights of the night sky spread shimmering above, the low pulse of a reddish moon setting in the west, stars from one horizon to the other dancing white with shades of orange and blue, and green and gold. It is a sight that for all of human history has inspired painters, writers, musicians, poets, storytellers, philosophers, scientists and dreamers. It is a sight that has forever helped define what it means to be human. And it is a sight that, thanks to light pollution (our overuse and misuse of artificial light at night), we have largely lost.

I have been lucky. I grew up in Minnesota, and my family has a cabin near a lake in the northern part of the state. All my life, for days or weeks at a time, I have visited this cabin and known real, natural night. I mean night without artificial lights everywhere cutting off our view of the heavens. I mean the Milky Way stretching overhead, the Aurora Borealis (Northern Lights) flashing its curtains and capes along the northern horizon, shooting stars scratching straight lines across the sky, and moonlight so bright it's possible to read. In researching my book, *The End of the Night*, I travelled to places such as the Sahara Desert in Morocco and Death Valley in California, to witness night skies so plush they seemed almost unreal. I am convinced that the natural lights of a starry sky and moonlight remain vitally important to our modern culture. With its ability to awe and amaze, to draw out our instincts to imagine and contemplate, the night with its natural lights is like a faithful friend,

always there, awaiting our return, its power to shape our dreams and beliefs and myths as strong as ever – if only we would remember.

#### **An ever brighter planet**

Of course we live in a time so different from Emerson's. Because of artificial light, we no longer know natural night. Satellite views of Earth after dark show vast areas of North America, Europe, the Middle East and Asia saturated with electric light. As cities and towns grow ever brighter, even rural areas have lost much of their natural night. Sadly, almost nowhere in our world is getting darker, and almost everywhere else is growing brighter. We have taken what was once one of the most common of human experiences – walking outside and coming face to face with the universe – and made it one of the most rare.

But we are foolish if we think that light pollution is only a problem for people who love the stars. For example, experts estimate that more than \$100 billion (US) is wasted worldwide each year on light pollution. Human physical health is endangered, as are the ecosystems on which we rely. Perhaps most surprising, our heavy use of artificial light actually reduces our safety and security.

The good news? Through our lighting designs and the designs of our buildings, the magic of the night can be returned. We can enjoy the benefits of artificial light without sacrificing the natural light that has long been half our lives.

#### **Light at night – a threat to human health?**

When it comes to light at night, we live in a dynamic age. More and more cities are replacing their electric lighting with LEDs (light emitting diodes). But in the long run, these new lights may actually make things worse because they contain high levels of what is called "blue-rich white light." This is the worst kind of light

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We have taken what was once one of the most common of human experiences – walking outside and coming face to face with the universe – and made it one of the most rare.

for humans and other creatures to be exposed to at night, as blue wavelengths tell our bodies to 'wake up,' and confuse our circadian rhythm, the 24-hour internal rhythm that orchestrates our body's physical health. A good analogy is to think of our body as an orchestra with each of our organs a musical instrument and our circadian rhythm the conductor. If the conductor is confused, the whole orchestra will be affected.

Second, exposure to artificial light at night contributes to sleep disorders. In the 21st century, more and more people, especially those living in cities, are reporting problems with getting enough sleep or enough good sleep. This lack of sleep is contributing to making many of us sick. Sleep researchers see a strong relationship between 'long light' – the increased amount of artificial light in our lives – and 'short sleep,' the reduced amount and quality of sleep. Researchers have linked a lack of sleep with an increased risk for obesity, diabetes and depression.

Third, and perhaps most troubling, scientists have discovered a link between artificial light at night and an increased risk for breast and prostate cancer. It turns out that we produce the hormone melatonin only in darkness – many call it "the darkness hormone" – and that exposure to artificial light at night impedes its production. Researchers have found that a lack of melatonin in the bloodstream increases the risk that cancers may develop, or develop further. When so many other things in our modern lives increase our risk of cancer, why would we want to add unnecessarily to those risks by exposing ourselves to artificial light at night?

#### **Nocturnal ecosystems**

Light pollution is also harming our environment. Some 30 per cent of vertebrate species, and more than 60 per cent of invertebrates, are nocturnal and many more are crepuscular (active at

dusk and dawn). All are threatened by our increasing use of light at night. As an Italian scientist told me, "We have levels of light hundreds of times higher than the natural level during the night. What would happen if we modified the day and lowered the light a hundred times?" His point is that "you cannot modify light half the time without consequences."

A few examples of these consequences include impacts to birds, sea turtles and insects. Most birds actually migrate at night, and light pollution confuses them and draws them into danger. Birds collide with lights, circle lights until they die of exhaustion, or are drawn into cities and collide with buildings. Similarly, sea turtles have evolved over hundreds of millions of years to hatch on beaches at night and to crawl toward the brightest light on the horizon. For hundreds of millions of years, the brightest lights were the natural lights of the moon and stars over the ocean, but now the brightest lights are often the hotels and streetlights – and so the baby turtles crawl away from the ocean and to their death. Finally, lights draw insects to their deaths in huge numbers. A new light set in a previously dark area draws insects toward it, and in so doing eliminates them from the ecosystem. Because so many other species rely on insects as food, when the insects die the entire food chain is harmed. We are only beginning to understand how damaging light pollution is for the environment, but one thing is for certain: life on earth evolved with bright days and dark nights, and every living thing needs darkness for optimal health.

#### **Why brighter is not always better**

But don't we need all this light for safety and security? In fact, while some light can help us be safer and more secure, more light does not automatically mean more safety. Unfortunately, we think it does; so we use unnecessary amounts of light

at night, and we use light in ways that actually make us less safe and secure. It's important to understand that light is not the problem – it's how we use it that's the problem. Think, for example, of the way bright lights make it harder for our eyes to see at night. This can often happen when we are driving, which can increase the danger of an accident. Also, bright lights cast shadows where criminals can hide – they can see us as we walk down the street but we can't see them in the shadows. And finally, bright light creates the illusion of safety, so that we think we are safe when actually we might not be.

No one is saying we should not have artificial light at night. But too often our use of light at night is irresponsible and wasteful. What we really need is thoughtful and intelligent lighting that helps us to see at night, rather than simply blasting light everywhere.

#### **Preserving the night: a strategy**

The good news is that light pollution is readily within our ability to control.

**1.** Architects, planners, and lighting designers can learn and understand the importance of natural light at night and the problems of light pollution, and can emphasise natural lighting at night in their designs and minimise the problems created by the overuse and misuse of artificial light.

**2.** We can shield our lights. In fact, simply by doing so we could cut light pollution in half overnight. Shielding our lights means making sure that they are only shining toward the ground rather than into the sky, into our eyes or into our neighbours' windows. The best time to do this, of course, is during the initial installation of lights, by choosing fixtures that shine light only downward. We also





can choose lighting fixtures that are programmed to dim or go off entirely during certain times of the night.

### 3.

We can work within our communities. Whenever new lights are part of a building design, we can make sure they are 'night-sky friendly' lights that shine only toward the ground. We can work to make sure that our government, schools, businesses, towns and cities choose lights that do not contribute to the problem. There is no reason to install new lights that shine into the sky or into our eyes. With older lights, we can demand that they be shielded or turned off. Old lights eventually burn out and must be replaced, so we can make sure that when they are replaced they are replaced with lights that reduce the problem of light pollution rather than make it worse.

All of these actions first require awareness that light pollution is a problem. Twenty years ago, most people had never heard of this concept, but that is rapidly changing. In a time of tight budgets and increasing concern over climate disruption, addressing light pollution is a relatively easy way of saving money and reducing our carbon footprint. Cities and villages in Europe and the US are leading the way in reducing their use of light. Even at the national level there is action, as France instituted country-wide lighting regulations in 2012 to cut carbon emissions, save money, and preserve the nocturnal atmosphere. Organisations like the International Dark-Sky Association are dedicated to raising awareness of light pollution worldwide. In short, there are so many reasons to control light pollution and virtually no reasons to let it grow. We can use artificial light responsibly and thoughtfully while respecting the natural lights of the night.

### Towards a new culture of lighting design

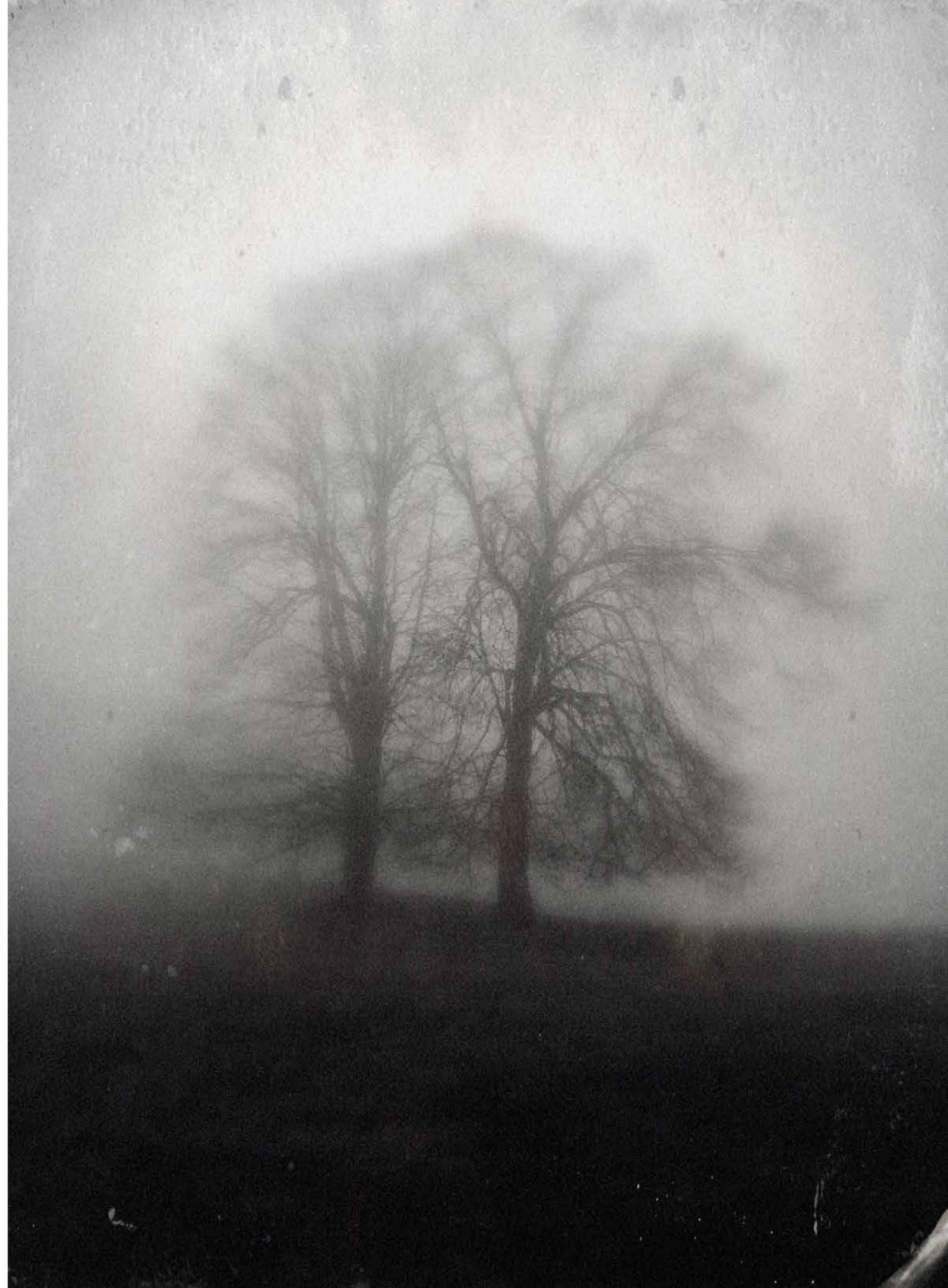
Too often, we in cities forget that night is half our life, half the day, half the world. I believe that we all share an instinctual love for the beauty of the earth, but because we have become so cut off from nature, we are not as concerned as we might be about what is happening. We are so cut off from natural darkness, for example, that we do not realise what we are losing as we flood our nights with artificial electric light.

Light at night has always been incredibly symbolic to human culture. A light in the distance can mean welcome and warmth, home and hearth. The natural lights above can mean inspiration and beauty. But in a world awash in too much artificial light, the main message we send is that we are wasteful and unthinking. Light pollution reflects a culture that cares little for the magic of the night – or, in general, for our use of the earth's limited resources.

On the other hand, building and lighting designs that welcome the natural lights of the night, that keep artificial light to a minimum, that are thoughtfully and intelligently lit, reflect a culture that recognises that the world's resources need conserving. When we light our nights with thought and care, we enhance the beauty of the cities and towns in which we live, and we make it possible for the magic of the night to reappear.

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**Paul Bogard** is a writer and assistant professor of English at James Madison University in Harrisonburg, Virginia, USA. He is the author of *The End of Night: Searching for Natural Darkness in an Age of Artificial Light*, and editor of the anthology *Let There Be Night: Testimony on Behalf of the Dark*, a collection of essays by twenty-eight wonderful writers on the value of darkness and the costs of light pollution. In September 2015, Paul Bogard was a key speaker at the VELUX Daylight Symposium in London. Find him at [paul-bogard.com](http://paul-bogard.com).







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# THE NIGHT SIDE OF LIFE

Most animal and plant species on our planet have evolved to be adapted to the regular shift from light to dark. They need the night for rest and orientation, for their habitat and shelter. The continually increasing amount of artificial light in our cities during the hours of night is therefore not just an aesthetic problem; it also has serious repercussions for the ecosystems of our planet and for human health.

*By Jakob Schoof*

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## WHEN NIGHT BECOMES DAY

Only one third of people live in areas where the sky they see at night is truly dark. This figure is much lower for Western Europe and North America where it stands at significantly less than 10 per cent. More than half the people living in these regions cannot even see the Milky Way at night because their residential environment is so brightly lit. And light emissions are constantly becoming stronger. According to some estimates, they have increased by 3–6% annually in industrial countries. In those areas of the world still playing catch-up in terms of electrification, this figure is as high as 20 per cent every year.

But even in industrialised countries the contrast between urban and rural areas is extreme; comparative measurements taken in 2015 showed that the night sky over Dutch conurbations was more than 10,000 times brighter than the sky above the Arizona desert. This difference is particularly pronounced when skies are overcast; the layer of cloud above cities acts as a reflector of light, while in thinly populated areas the clouds deflect the light of the moon and stars away from the Earth.

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## AN ECOSYSTEM CHANGED BY LIGHT

Almost 80% of all butterflies and moths and 60% of all beetles are nocturnal. Their eyes are immeasurably more sensitive to light compared to the human eye. Certain moths can still perceive colour on nights with a new moon and only starlight to help them. On very dark nights, bright lights exert an almost magical attraction on insects. A single street lamp will attract insects within a radius of 500–700 metres, a veritable ‘vacuum cleaner’ effect. Because street lamps are usually positioned at regular intervals of 30–50 metres, well lit streets constitute an almost insurmountable barrier for insects. As insects form the base of the ‘food pyramid’ that other species rely upon to survive, this can have serious effects on local ecosystems.

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## THE STARS AS GUIDES

Migratory birds are among the most mobile creatures in existence. Some species cover distances of more than 20,000 kilometres on their annual migration. To do this, some species use the polarisation of sunlight to orientate themselves. Others only travel at night, using the stars as their guides. They also have an inner compass that registers the Earth’s magnetic field. Scientists now suspect that this compass is sited in the birds’ vision system. Special light receptors allow them to convert magnetic signals into visual information.

Bright light at the wrong time can lead birds astray, as was demonstrated in an experiment carried out on a high-rise building in Bonn. Two thirds of all birds that flew through the beam of light emitted by a floodlight placed on the building’s roof deviated from their original course by more than 45 degrees; some of them even turned around. Measurements using target tracking radar showed that, even afterwards, the birds did not correct their flight direction.

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## LIGHT BARRIERS UNDER WATER

Every autumn, the European eel begins its migration from Europe's rivers to the Sargasso Sea off the coast of North America to spawn. The eels move almost exclusively at night. Even low light intensities – for example, from street lamps on bridges or the banks of streams – can interfere with or delay the eels' progress. The consequences for the European eel are similar to those reported for migratory birds – migration requires more time and energy, which jeopardises the reproductive success.

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## EARLY RISERS IN THE CITY

Blackbirds living in towns are active for around 40 more minutes every day than blackbirds living in the country. In extreme cases – for example, in winter when the time of natural daylight is particularly short – the difference between the two groups can be as much as five hours. Scientists primarily blame environmental factors such as artificial lighting and the noise levels in cities for these differences.

But ornithologists have found that light also affects the mating behaviour of birds. Light at night can result in the testes of male birds maturing up to one month earlier and female birds may start nesting three weeks earlier. Even relatively low illumination levels of 0.3 lux, which correspond to around one twentieth of the brightness of a street lamp, can be enough to trigger this effect.

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## WHAT'S FLOWERING HERE?

Many plants also use daylight for orientation. The sprouting of leaves, the start of the flowering season, the falling of leaves in autumn, and the growth rates of plants are regulated by the amount of daily exposure to light. This phenomenon is also known as photoperiodism. Plants are capable of precisely registering the length of days to within 10 to 15 minutes. For some plant species, even full moon nights have a biological impact.

While some types of flowers respond to the lengthening of the days in spring, others only start to flower in the autumn when the days become shorter. For the latter species of plant, the emission of artificial light at night, even if only for a few minutes, may be sufficient to prevent them from flowering.

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## HUMANS AND THEIR CIRCADIAN RHYTHMS

The impact of light on our inner clock is best explained by the British neurologist, Russell Foster: "Under normal conditions, we experience a 24-hour pattern of light and dark, and our circadian clock uses this signal to align biological time to the day and night... Body temperature drops, blood pressure decreases, cognitive performance drops and tiredness increases in anticipation of going to bed. Whilst before dawn, metabolism is geared-up in anticipation of increased activity when we wake.

Few of us appreciate this internal world, seduced by an apparent freedom to sleep, work, eat, drink, or travel when we want. But this freedom is an illusion; in reality we are not free to act independently of the biological order that the circadian clock imparts. We are unable to perform with the same efficiency throughout the 24h day. Life has evolved on a planet that experiences profound changes in light over the 24h day and our biology anticipates these changes and needs to be exposed to the natural pattern of light and dark to function properly."



# SPORT

## 56 SUNRISES

*Sports hall in Klaus*

Architectural design, ecological aspirations and a high standard of education enter into a close symbiosis in the Austrian federal state of Vorarlberg. The secondary school in Klaus conceived by Dietrich | Untertrifaller set standards in this regard as long as 14 years ago. For the young people who use it, the classrooms and corridors of the energy-efficient timber building offer plenty of room for movement and an abundant supply of daylight. The architects have now supplemented the school with a gymnastics and multipurpose hall that is based on the same planning principles. Towards the street, the new annex is closed off by a windowless wall with timber cladding, but the interior spaces allow daylight to stream in.

In the main corridor, which separates the sports hall in the south from the group rooms in the north, a continuous strip of skylights opens up a clear view of the sky. Above the hall, a cross-laminated timber girder grid supports the roof and admits daylight at the same time. Between the roof beams, the architects inserted 56 'daylight pyramids' made of birch plywood, each of which has a flat roof window at the top. Neighbouring pyramids always have different cross-sections so that daylight is evenly distributed throughout the hall, irrespective of where the sun stands in the sky. Some of the flat roof windows can be opened electrically, which makes them an essential component in the ventilation concept of the building.

**LOCATION:**

Treietstrasse 17, Klaus, Austria

**CLIENT:**

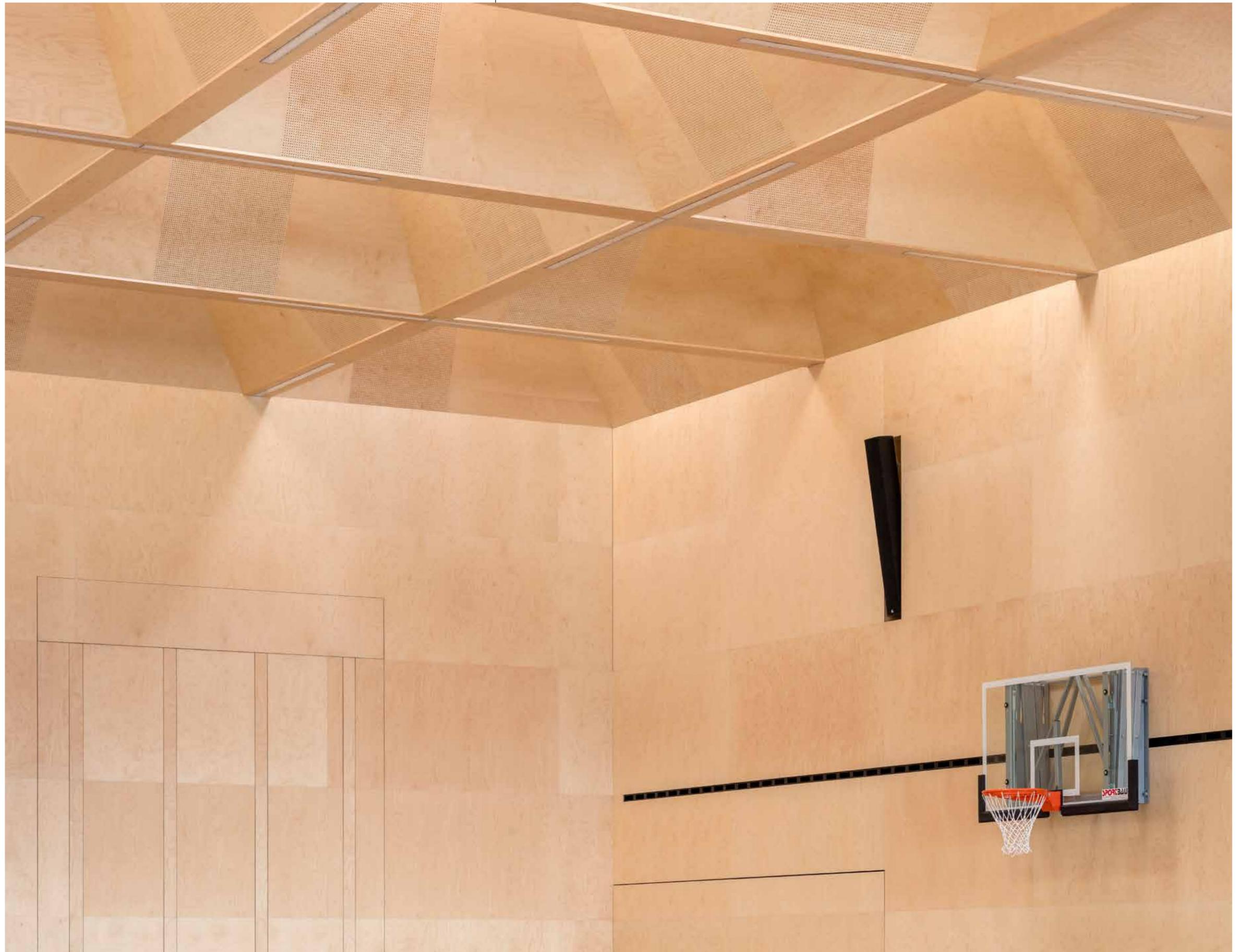
Municipality of Klaus

**ARCHITECTS:**

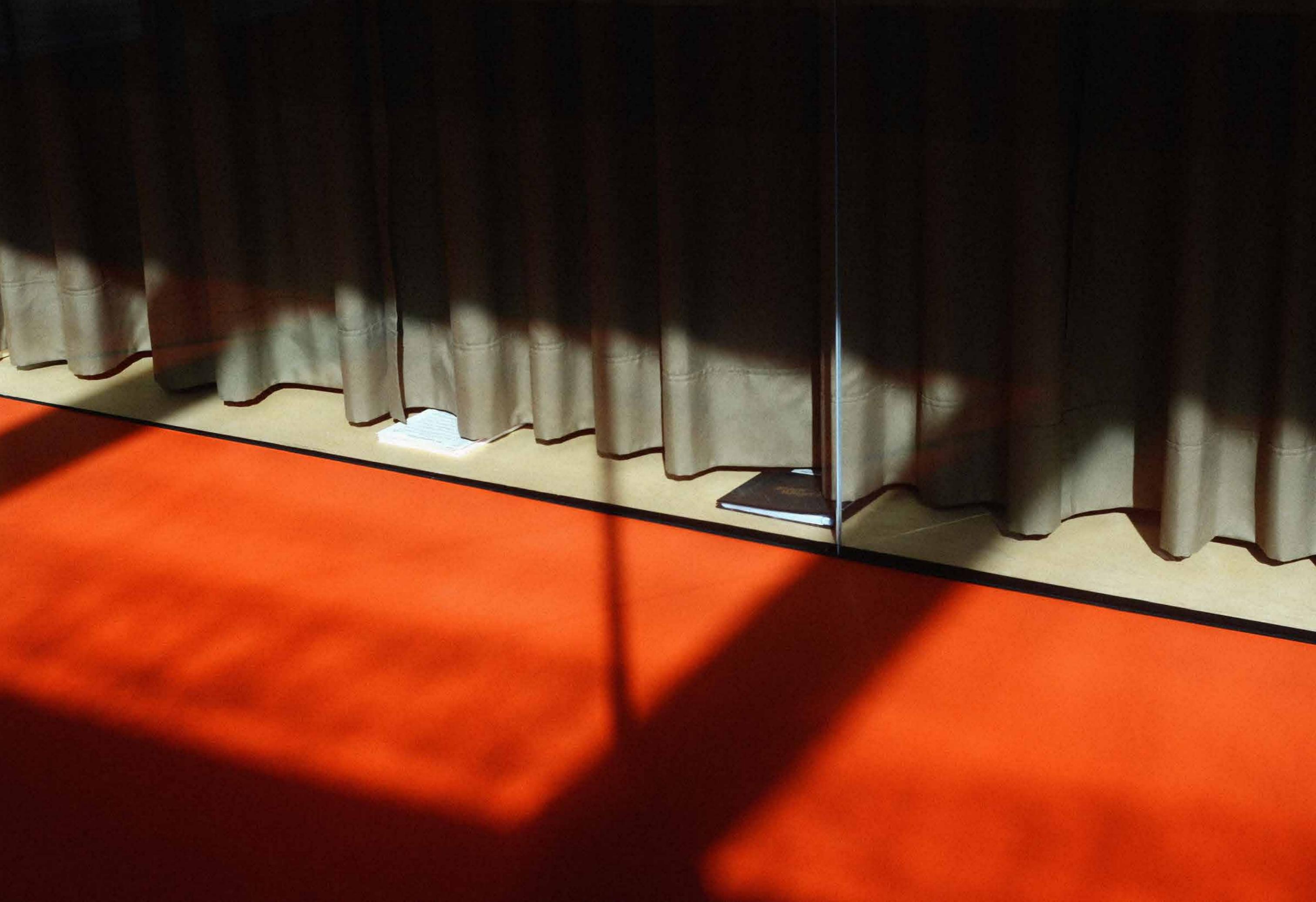
Dietrich | Untertrifaller, Bregenz

**DAYLIGHTING DESIGN:**

teamgmi, Schaan











# STABLE

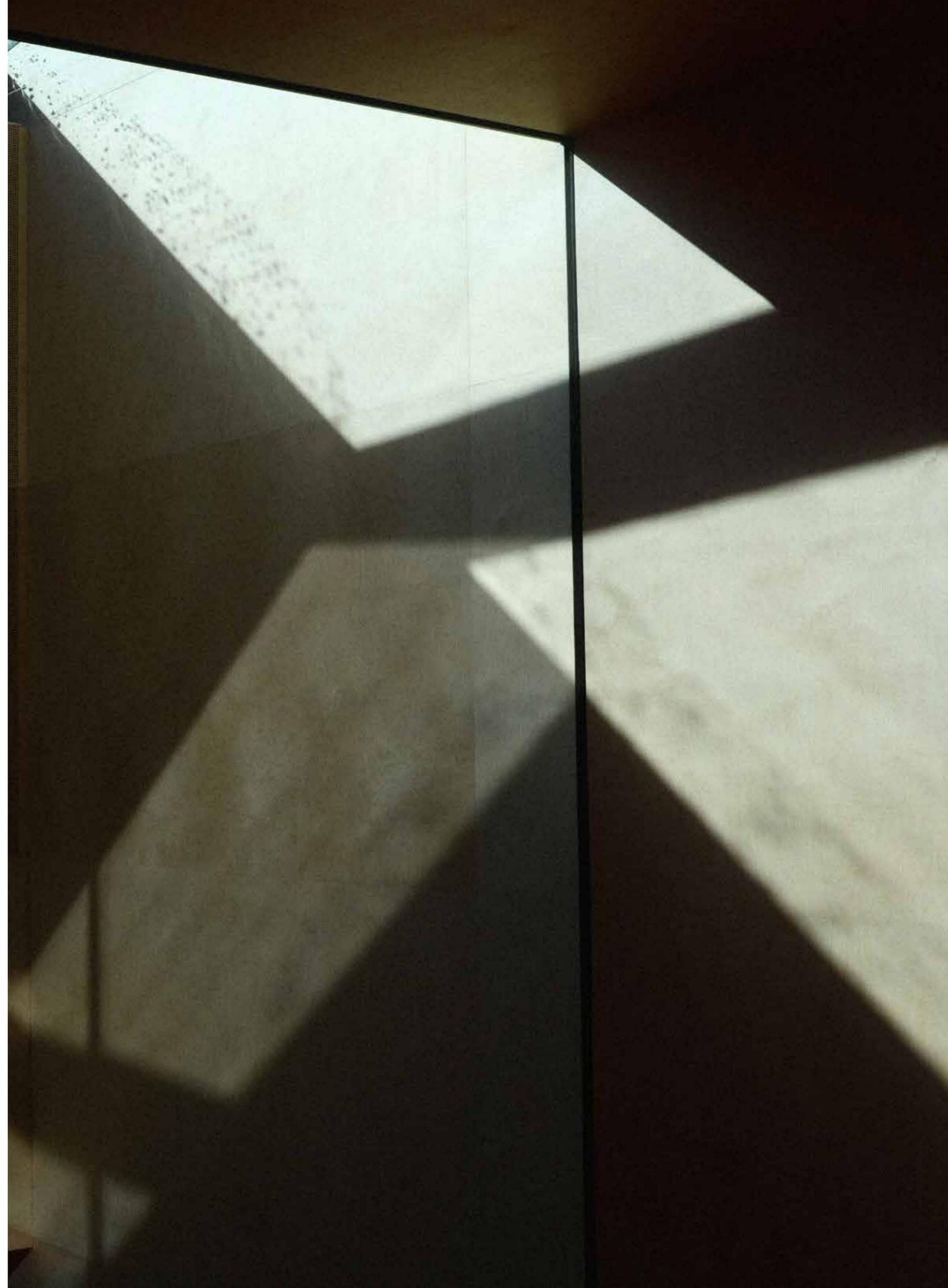
## A VIEW OF THE SKY

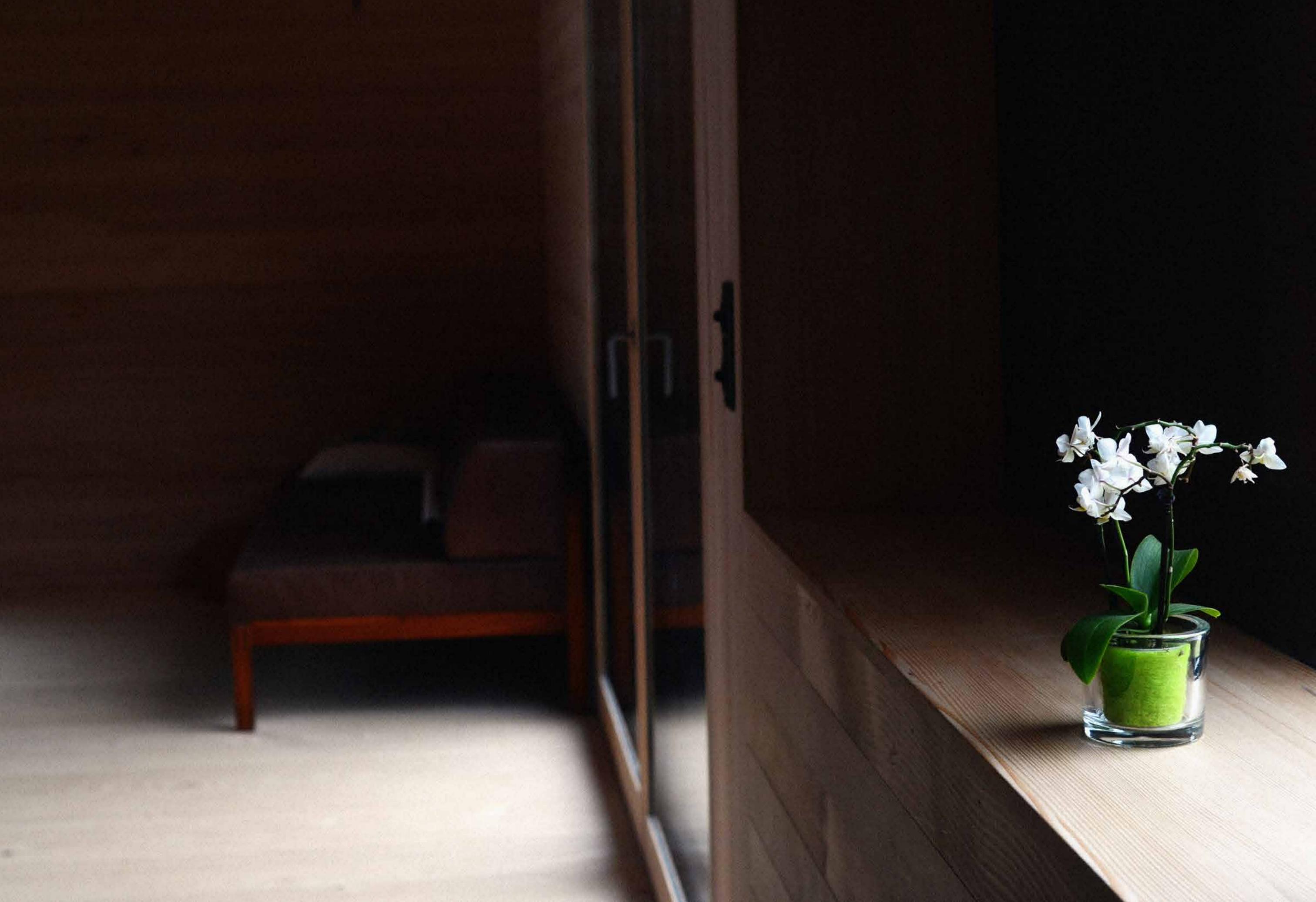
*Conversion of a stable in Tschagguns*

Like many Alpine locations, the Vorarlberg municipality of Tschagguns lives primarily from tourism, whereas farming is on the retreat. In some cases, however, at least the architectural heritage of the past can be saved. Such is the case with a stable from the end of the 19th century that architect Bernhard Breuer has converted into a home. The existing building had a beautifully ornate wooden facade that had been blackened by the weather over time. At its north-east corner, it featured a solid ashlar base – the other facades were made of simple wooden boards, through the cracks of which the wind would whistle.

Behind this old shell, Bernhard Breuer inserted new interior walls and ceilings with surgical precision, mainly making use of traditional carpentry techniques. From the outside, the former stable can still be easily recognised but large windows with narrow frames now allow copious amounts of daylight into the living areas. There is also an abundance of light on the upper floor thanks to three roof windows. At night, the owners can contemplate the unique starlit sky above the Alps through the same roof windows. The opposite side of the roof, which faces south-west, is used for energy generation. Photovoltaic and solar thermal modules supply the house with electricity and meet a large part of the heating needs.

LOCATION:  
Mühleweg 2, Tschagguns, Austria  
CLIENT:  
Rosa Breuer  
ARCHITECT:  
Bernhard Breuer, Schrunts





# FORUM

## THE FUTURE IS GREEN

*Conference center and hotel extension  
in Rønne*

Nowhere in Denmark does the sun rise earlier than on Bornholm – and the Baltic Sea island would also like to be the first part of the country that meets its energy needs from completely carbon-neutral renewable sources. The ‘Green Solution House’ in the south of the island’s main town, Rønne, is a lighthouse project for this turnaround. The former Hotel Ryttergården from 1973 has been renovated, supplemented with a congress centre and equipped with numerous forward-looking solutions from the fields of architecture and building technology. Three sustainability concepts were at the centre of the building design: DGNB certification, the cradle-to-cradle principle aimed at a circular flow economy, and the Active House Standard, which focusses on a healthy indoor climate and an excellent supply of daylight.

The results of this strategy are apparent to visitors everywhere they go. In many places, recycled materials were used; there are carpets that clean the air and a small bioreactor in which algae are used to clean the hotel’s waste water. Above all, however, daylight and the coastal landscape are omnipresent all round the inside of the building. The hotel rooms receive light through the flat roof windows and via the balconies, which have been fitted with new glass balustrades. Above the foyer, there is a folded glass roof composed of modular skylights, some of which are fitted with solar cells and thus contribute to the power supply. And thanks to large glass facades, the sunlight can exert its invigorating effect on listeners and speakers even in the conference rooms.

### LOCATION:

Strandvejen 79, Rønne, Denmark

### ARCHITECTS:

3XN, Copenhagen

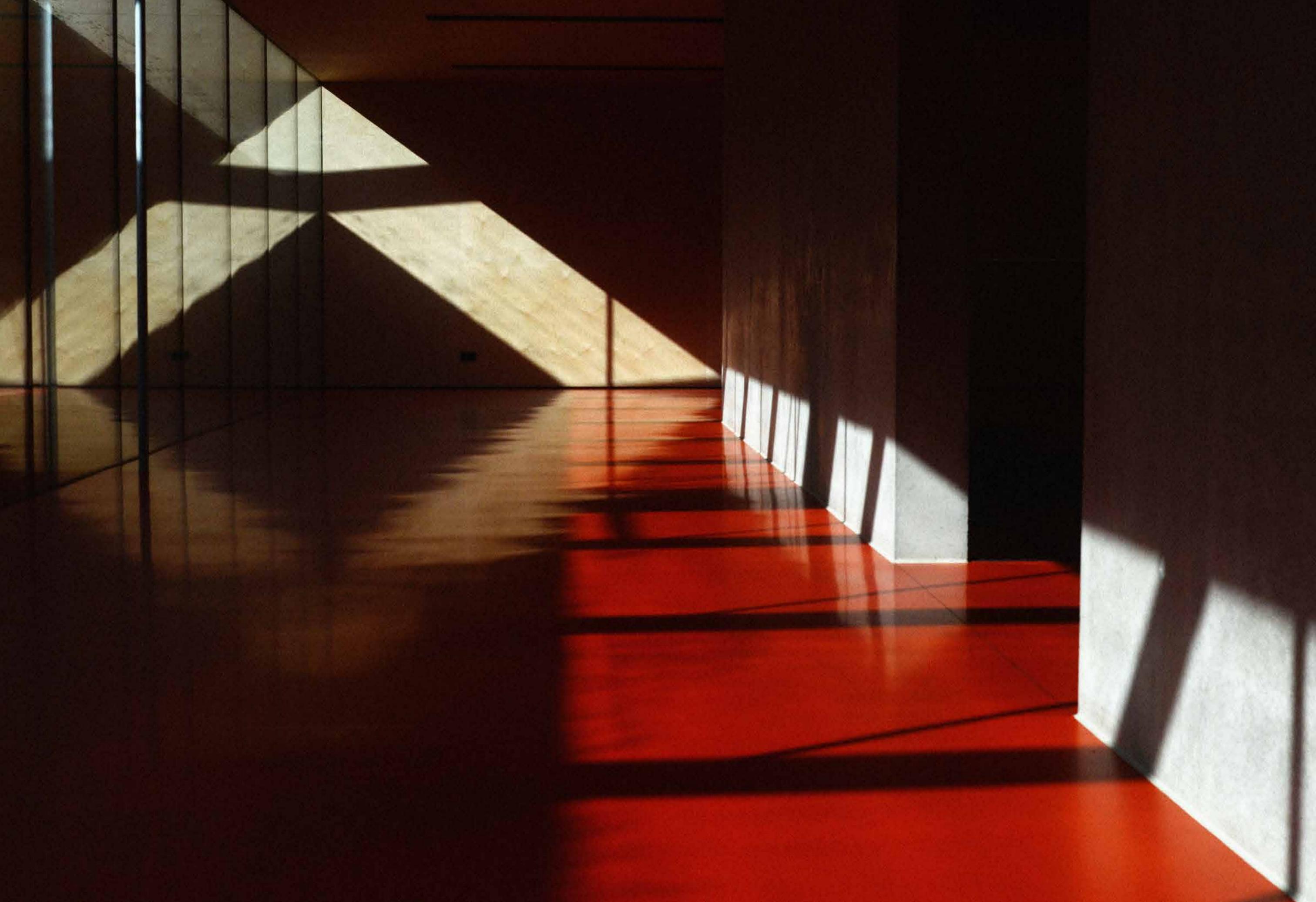
Steenbergs Tegnastue, Rønne

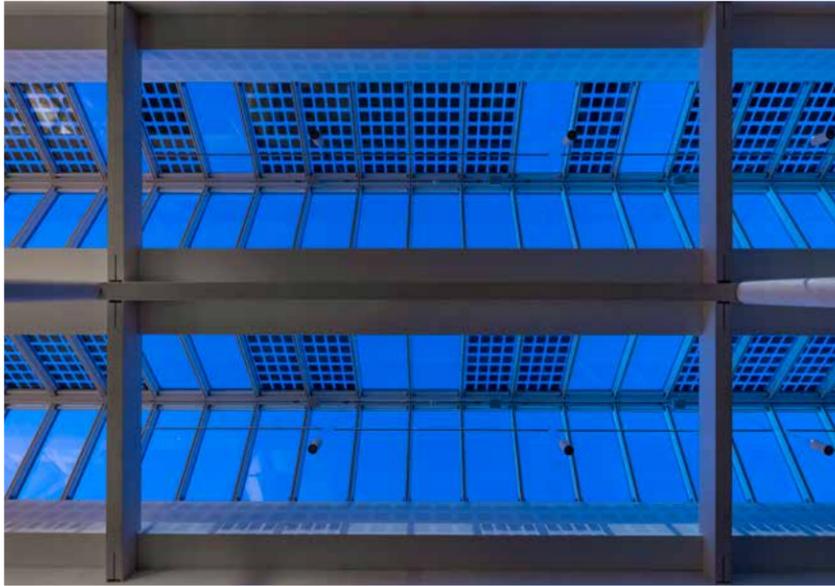
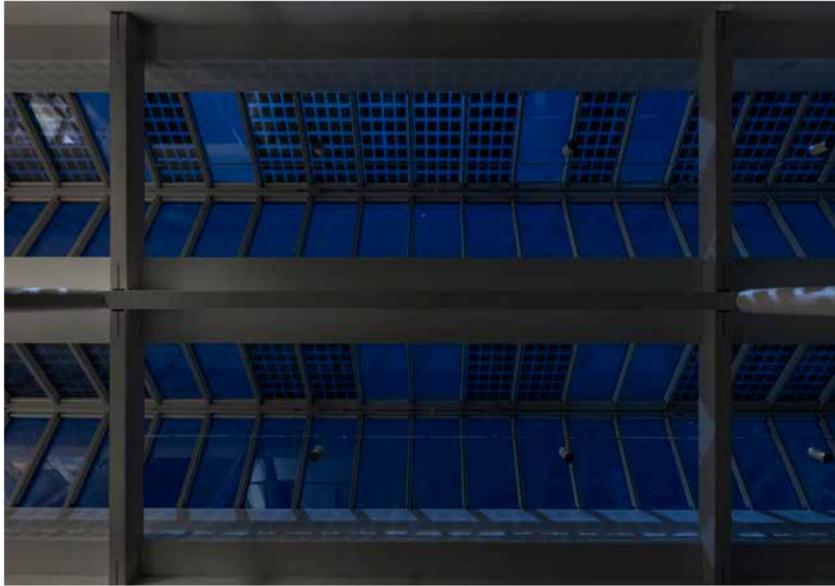
### SUSTAINABILITY CONSULTANTS:

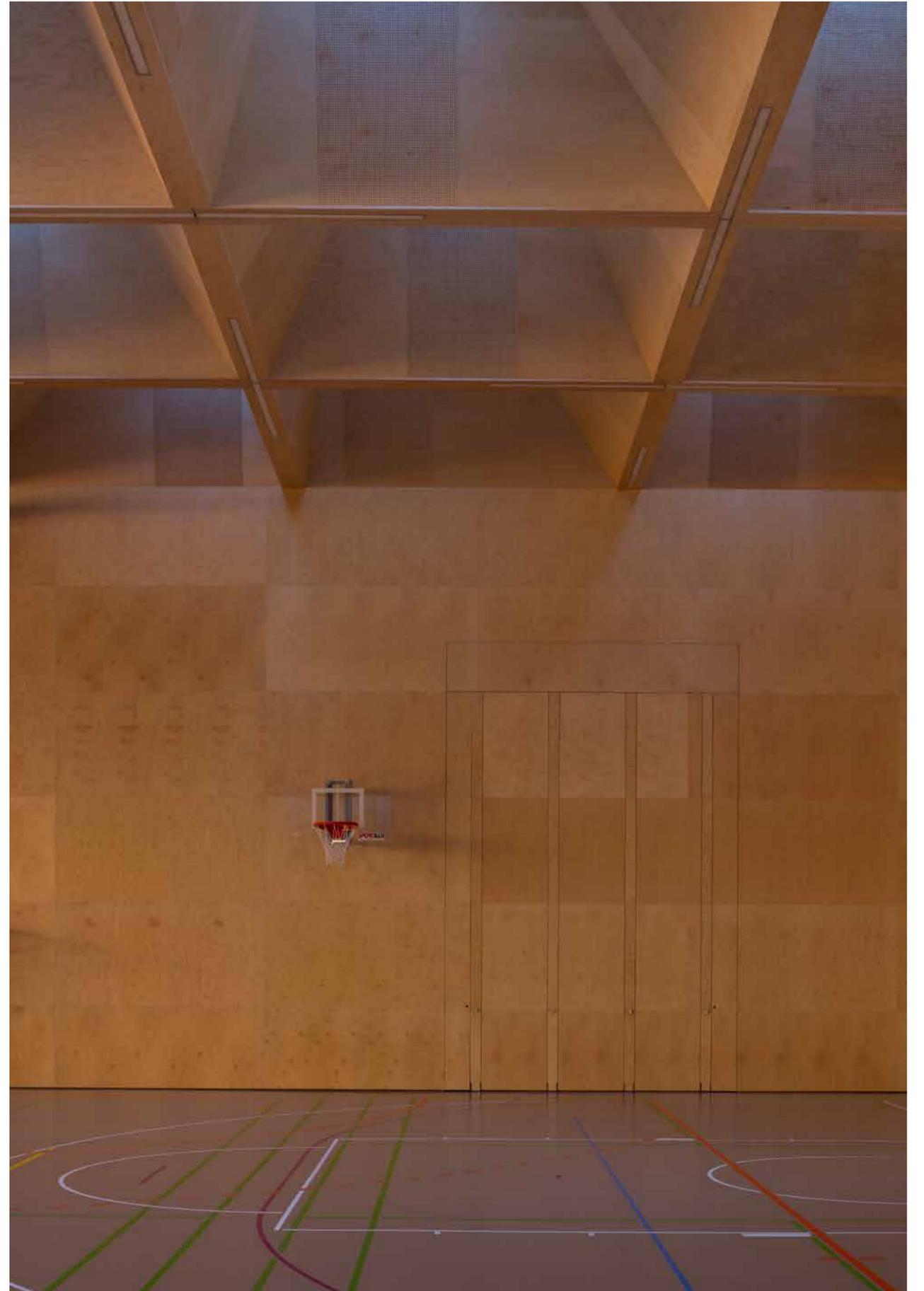
GXN Innovation, Copenhagen













# GYM

## ACTIVITY HUB FOR EVERYONE

*Sports and multipurpose hall  
in Copenhagen*

The Arsenaløen island is located between the Copenhagen Opera and the hippie “free state” of Christiania in the centre of the Danish capital. Its current use corresponds well to this position between high culture and subculture. A ‘green oasis’ for everyone has now developed where, in former centuries, the Danish navy used to store weapons and ammunition. The sports fields are eagerly used by local schools and sports clubs, there is a campsite for scouts in a small nearby woodland and, in summer, canoeists paddle along the many canals around Arsenaløen.

Many of these activities are centred around ‘Hal C’, a two-storey building with red-painted timber cladding, which houses a large sports hall, a dance studio, fitness area and a large open conference room. Every day from 8 a.m. to 11 p.m., you can follow the hustle and bustle of students, athletes, visitors and passers-by in and outside the building.

Whereas the dance studio and conference room are located on the first floor, the latter with a sweeping view towards the city centre, the sports hall on the ground floor opens out onto the sports fields and the nearby canal via high windows on either side. External wooden shutters keep off direct sunlight and heat, so that the athletes inside benefit both from outside out and a pleasant indoor climate.

This is further enhanced by four rows of modular skylights, which bring natural daylight into the centre of the building. Three of these are located above the sports hall while the fourth is positioned above the staircase to the first floor. All skylights are inclined 20° north and inserted in deep light wells to prevent glare and ensure an even light distribution. Some of the modules can be opened for natural ventilation, providing a fresh indoor climate that is ideal for workout, public meetings and other cultural events.

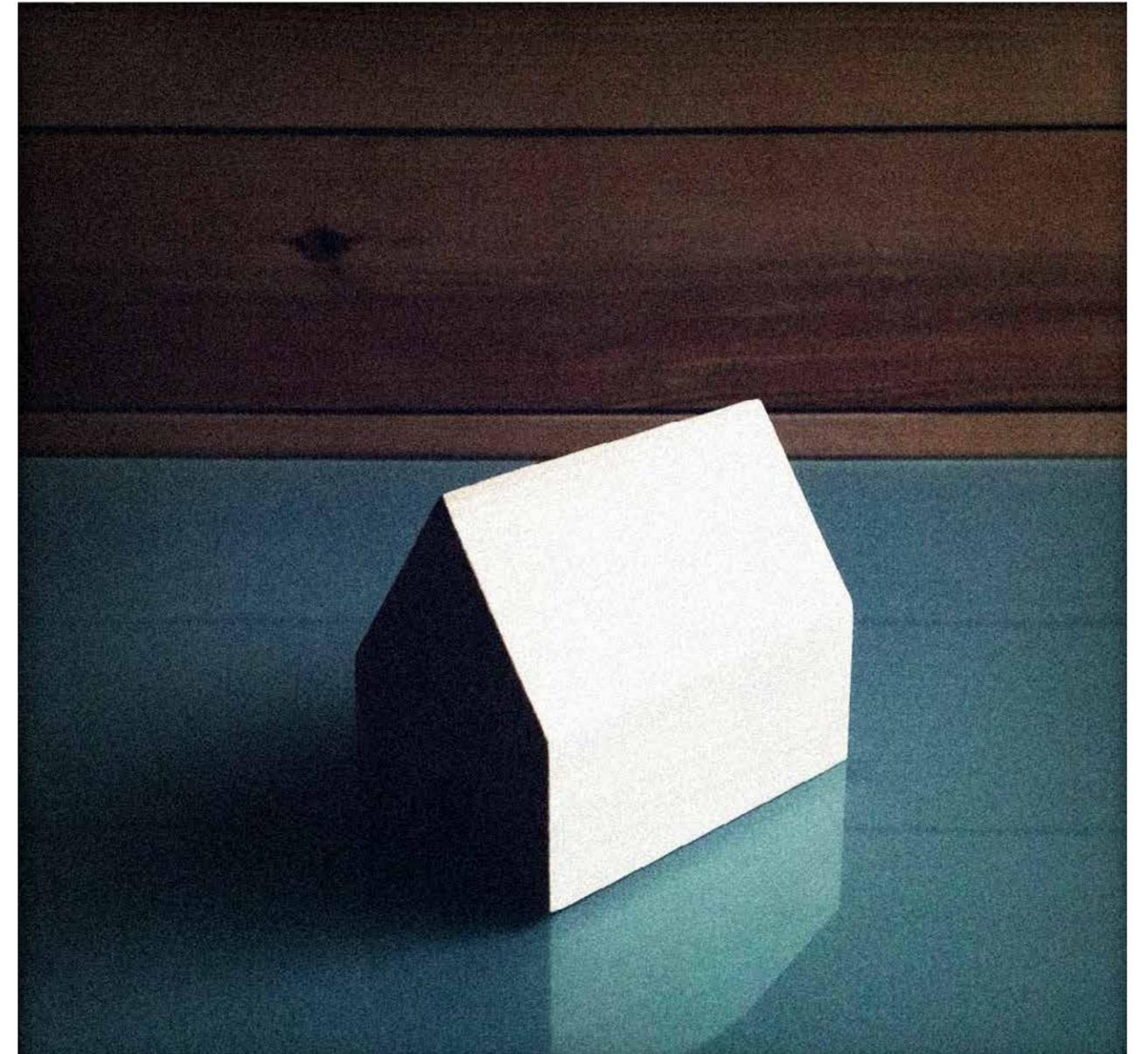
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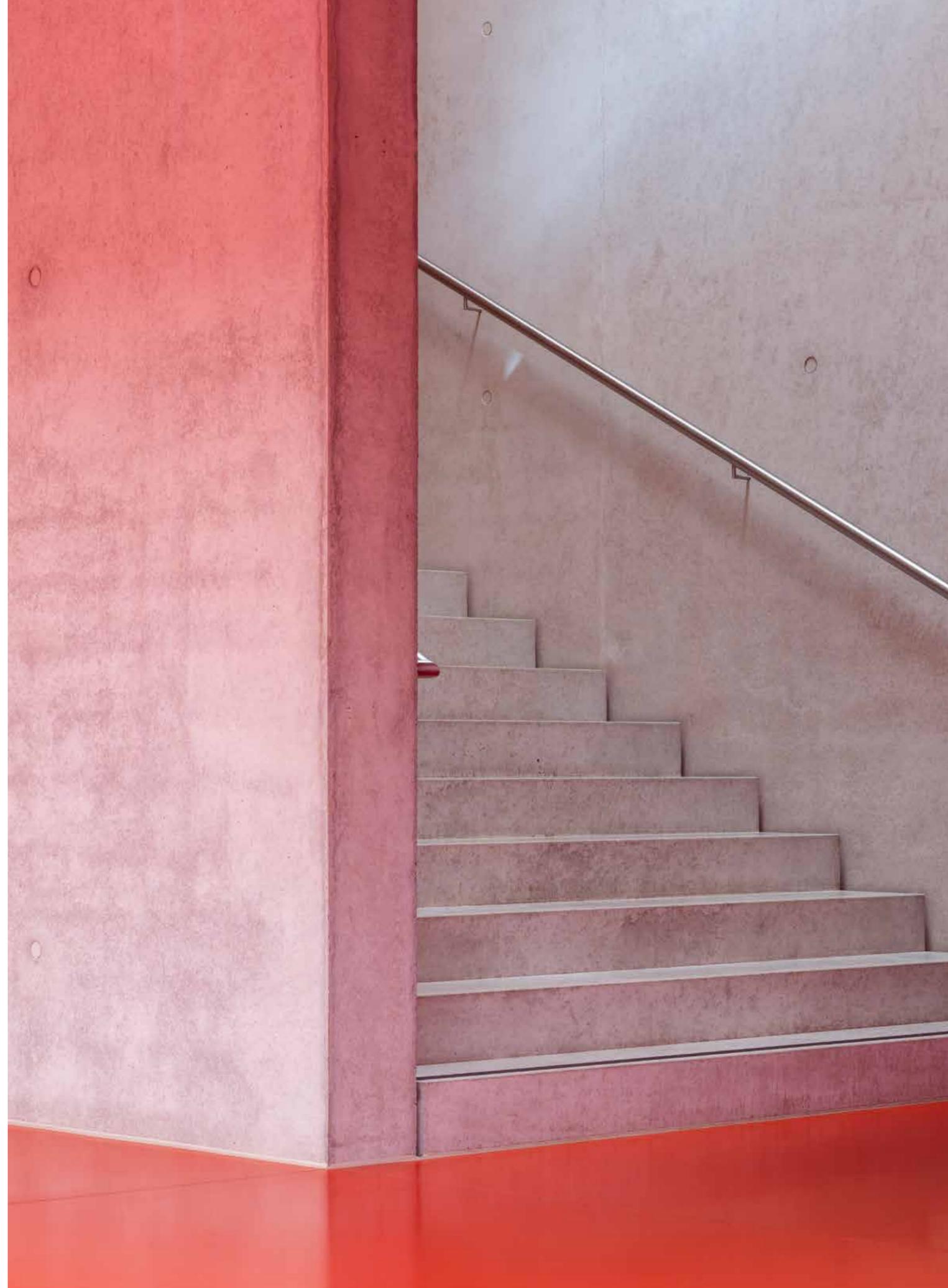
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City of Copenhagen

ARCHITECTS: Christensen & Co.  
Arkitekter, Copenhagen



15:17







# NIGHT,

# WHAT ART THOU GOOD FOR?

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Although night-time in the centuries before electric lighting often appeared fraught with danger, no other realm of ordinary life afforded so much autonomy and personal privacy to so many, including opportunities for human intimacy and self-reflection. With our 24-7 mindset and light pollution spreading across the globe, rather than rendering night-time more accessible, we are increasingly risking its gradual elimination. In John Dryden's comedy *Amphitryon* (1690), the ancient deity Mercury demands of Night, "What art thou good for?" In view of the present trajectory of technological change, we might well pose the same question today.

By A. Roger Ekirch

Currently, we inhabit a nonstop culture. Any number of metropolitan areas in the world, bathed in the glare of neon and mercury vapour, market themselves as 24-hour cities. Besides boasting all-night television and radio, along with petrol stations and supermarkets, evening has become the primary time of employment for an expanding segment of the Western workforce, not to mention millions of people working a second job as 'moonlighters.' In the United States today, in an effort to stretch their waking hours, perhaps 30 per cent of adults average six or fewer hours of rest a night, while many adolescents, encouraged by social media and the internet, reportedly disdain sleep as a waste of time.

Only in recent years have the costs of our high-wattage lifestyle become clear – literally – in financially troubled cities in Europe and North America forced to reduce their dependence on street lighting. In a Detroit suburb, a utility company tore more than one thousand lamp posts from the ground. Joining cost-conscious communities in their concern are opponents of light pollution. As leaders in the 'DarkSky' movement, astronomers lament the difficulties of probing a universe in which entire constellations have disappeared from sight, replaced by a blank sky. Alternately, the glare of outdoor lighting has inflicted ecological damage upon plant and animal life, with the disruption to migrating birds and young sea turtles just two of the consequences. More recently, scientific research has identified a variety of health risks to humans due to artificial illumination at night, including a heightened incidence of breast cancer, diabetes and obesity.

Even our sleep, apart from being diminished in length, has been altered. Before the twentieth century, the sleep of Western families was segmented, consisting of a 'first sleep' and a 'second sleep' of roughly three to three and a half hours apiece bridged by an hour so of wakeful-

ness around midnight. In addition to performing domestic tasks, making love and reciting prayers, people emerged from their 'first sleep' to reflect upon nocturnal visions from which they often awakened. Well before Sigmund Freud, Europeans prized dreams for their personal insights, including what they revealed of one's relationship with God. "Let the night teach us what we are, and day what we should be," wrote an English commentator in 1691.

#### **Animated nights in the past**

Night was man's first necessary evil, our oldest and most haunting terror. In the centuries before the Industrial Revolution, darkness seemingly conjured the worst properties in man, nature and the cosmos – brigands, rapacious beasts and satanic demons were thought to lurk everywhere. Night, a sixteenth-century poet remarked, by reviving the dead, threatened the living with death. "The night is no man's friend," warned a well-known adage.

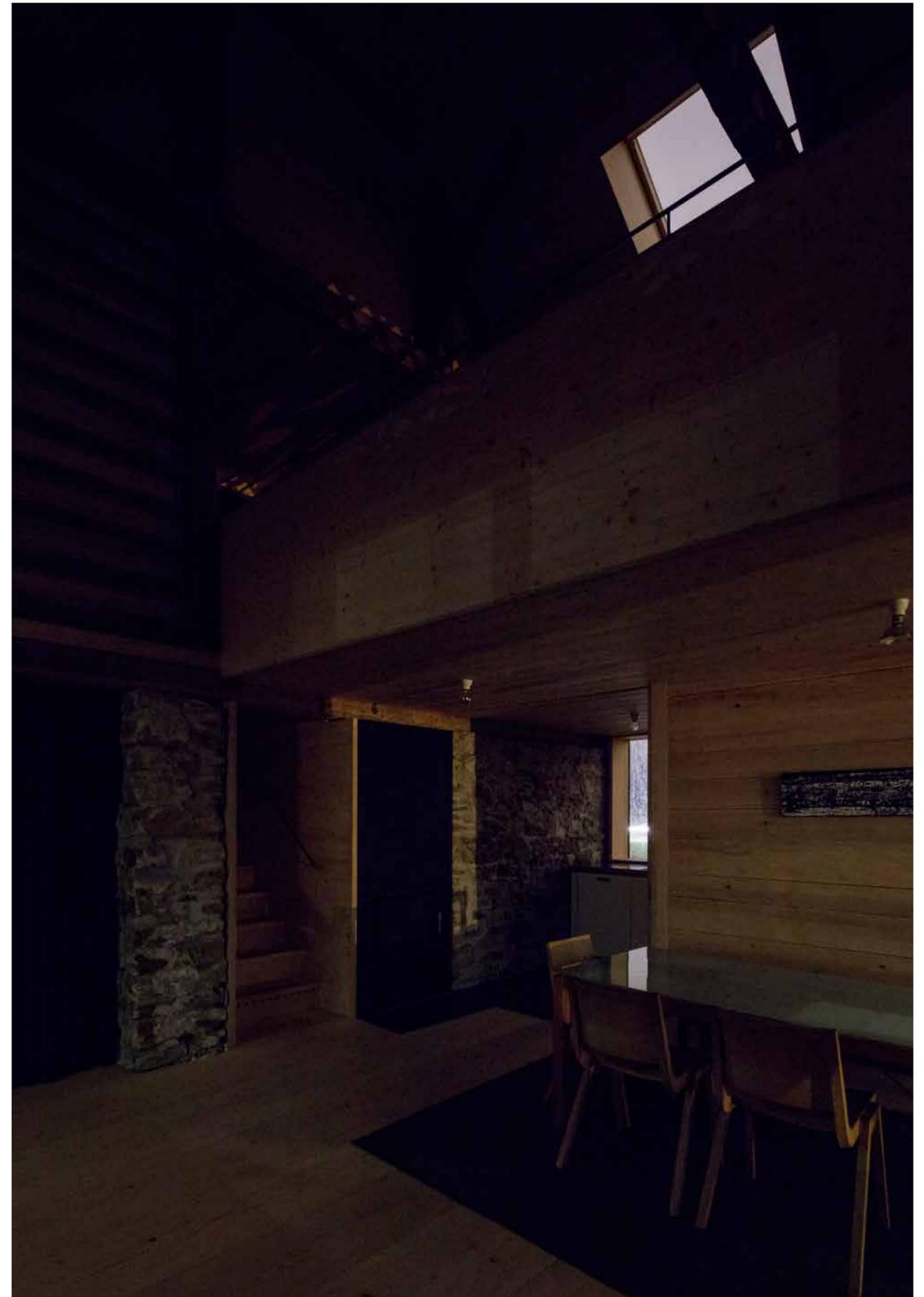
It is a wonder that, with the initial shades of darkness, men and women did not flee to their beds after barring doors and banking fires. And yet many people retreated neither to their chambers nor even to their homes. Instead, they chose to work and play into the night, often gathering with kith and kin, swapping stories and neighbourhood gossip while performing chores requiring minimal light – beating hemp, weaving baskets and, in America, husking corn. A Swiss pastor in 1699 complained, "In the evening, when the sun is setting, the cattle returning from the field home to the stall, and the birds in the wood are falling silent, man alone in his foolishness acts against nature."

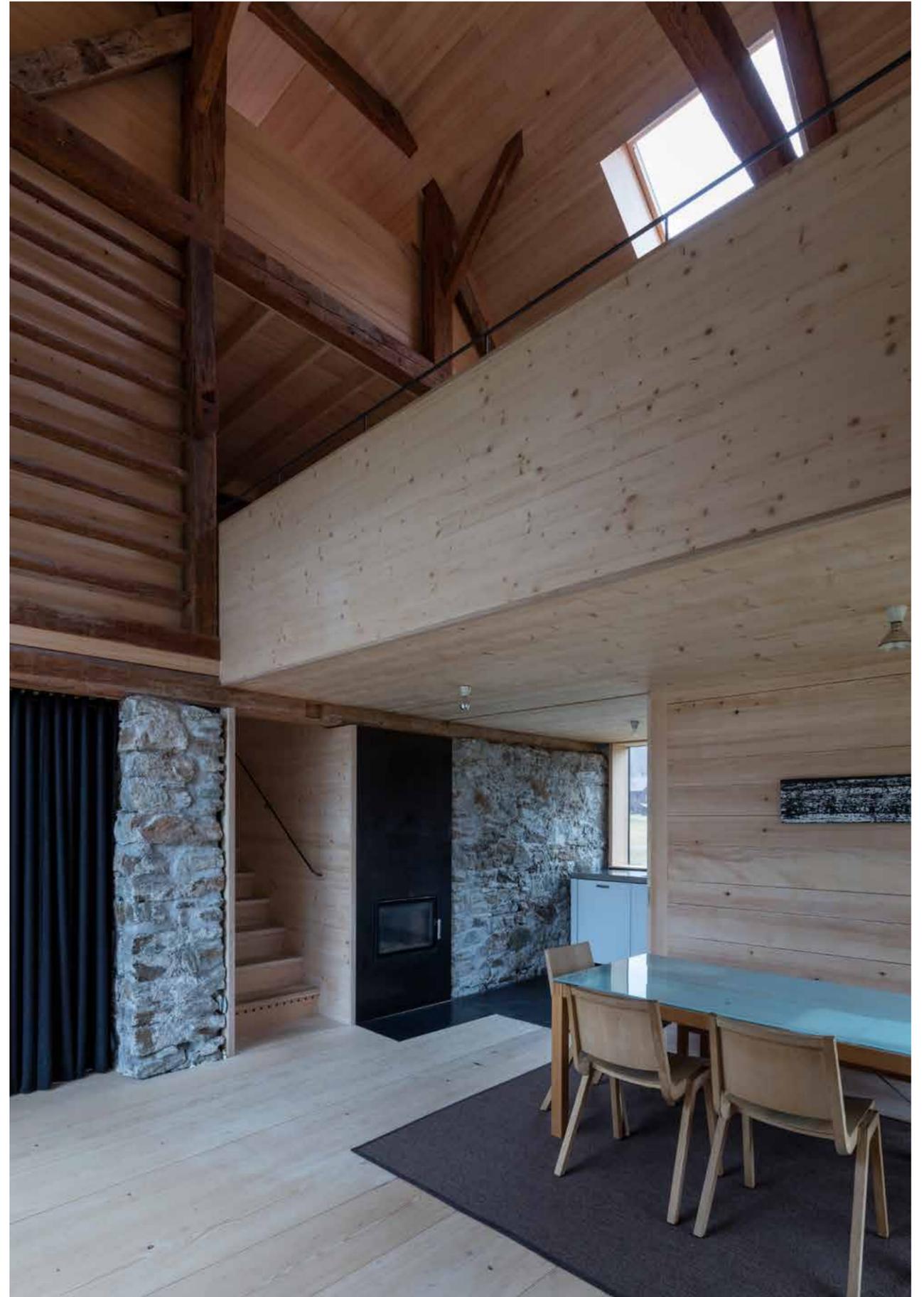
#### **Navigating the darkness – with all of our senses**

Most men and women were surprisingly well equipped to traverse nocturnal dark-

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Before the twentieth century, the sleep of Western families was segmented, consisting of a 'first sleep' and a 'second sleep' of roughly three to three and a half hours apiece bridged by an hour so of wakefulness around midnight.







ness. When treading outdoors, they drew on a deep reservoir of popular lore as well as an intimate awareness of their natural surroundings. Beginning at an early age, children committed to memory an intimate map of their villages, including every ditch, pond and graveyard, or in towns and cities, shop signs, doorways, and back alleys. Many, too, relied upon the heavens for illumination. On moonless nights, there was the natural light of the stars. Besides appearing brighter than today, stars, to the naked eye, were vastly more plentiful, likely totalling, on a clear evening, in excess of two thousand, with the Milky Way a broad swathe of white light, stretching from one horizon to another. On the blackest nights, wayfarers displayed a rough-hewn resourcefulness, relying upon hearing, touch and smell rather than sight. Although the large bulk of our sensory input today is visual, sight's sister senses for much of the pre-industrial era became critical at night. "The day has eyes, the night has ears," affirmed a Scottish proverb. Sounds represented the equivalent of aural landmarks. Where wind and rain, by their repetition, could help to reveal the contours of a landscape, familiar noises afforded welcome wayposts, whether bleating ewes, barking dogs or tolling church bells. Touch, on the other hand, enabled individuals to navigate at close quarters. Visiting a patient without the aid of a lantern, the New England midwife Martha Ballard removed her shoes to feel the wilderness path in her stockings. "Steerd as strait a coarse as I could," she recorded of her safe arrival.

#### **Refugees from daylight**

Nocturnal darkness prior to the Industrial Revolution spawned a surprisingly rich and vibrant culture, with many of its own customs and rituals. Rather than a backdrop to daily existence, or a natural hiatus, evening, as a mark of its special

nature, was frequently known as the 'night season.' Contrary to the dismissive description of an English poet – "no occupation but sleep, feed, and fart" – changes occurred after dark not only in dress, diet and social gatherings but also in popular mores, including attitudes toward magic, sexuality and the law. More than that, for the greater part of the population, darkness afforded a sanctuary from daily reality, the chance for men and women to express inner impulses and realise repressed desires in both their waking hours and their dreams. A time, fundamentally, of liberation and renewal, night gave free rein to the good-hearted as well as the wicked, forces both salutary and malignant in ordinary life.

While all social ranks enjoyed a greater measure of personal autonomy, including slumming noblemen in ramshackle alehouses, refugees from daylight more often included vagrants, the diseased and disabled, religious dissenters, homosexuals, servants and, in America, African-American slaves, of whom one Southern master observed, "Night is their day" – all seeking, as a French saying went, to make "a hole in the night," or, as a Spanish rabbi remarked, "to hide from the world." For the indigent and the dispossessed, light was not an unalloyed blessing nor darkness invariably a source of misery. Night freed untold numbers from the control of their betters, allowing opportunities to engage in poaching, smuggling and pilfering. Of Italian peasants, a poet complained, "At night, they make their way as the owls and steal as robbers." Despite surveillance by landowners and masters, fields were too large, forests too dense and nights too dark. And, naturally, it was at night that collective resistance occasionally erupted against the established order, whether in the form of English Luddites destroying farm machinery, rural peasants resorting to arson, or slaves in the Americas fomenting rebellion.

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### Making night into day

For the past three centuries, night-time has been besieged by the steadily advancing forces of light. Already by the early 1700s, major European cities had installed oil lamps on public streets to curb rising fears over crime and urban disorder. At stake, in the view of civic functionaries, was the sovereignty of the public arena. Who at night should rule: thieves, prostitutes and other urban riff-raff, or their social superiors, including members of an expanding bourgeoisie? In 1746, a Parisian proclaimed with delight, "THE REIGN OF THE NIGHT is finally going to end."

With the arrival of the Industrial Revolution, accompanied by gas, then electric, lighting, and the rise of professional police, ages of primordial darkness were pushed back, much to the delight of members of a public anxious to pacify urban spaces for both pleasure and profit. With little exaggeration, the author of *Berlin Becomes a Metropolis* remarked in 1868, "Since the invention of gas light, our evening life has experienced an incredible intensification, our pulse has accelerated, nervous excitation has been heightened." Artificial illumination arguably became the mightiest symbol of modern progress. Thomas Edison's injunction – "Put an undeveloped human being into an environment where there is artificial light and he will improve" – carried the night along with the day.

Even so, public lighting from the outset was never universally popular, a historical fiction too readily accepted given its longstanding association with social and economic progress. Street lights, in cities and rural towns, often invited scepticism at best among the society's 'lower orders'. At worst, lamps made easy targets, much to the frustration of urban authorities. After the installation of oil lights in Paris in 1667, an ordinance threatened to imprison "pages, lackeys,

and all other persons of bad life and disturbers of public peace and security who would break any lanterns." In poor sections of Georgian London, where lamps hung by day, they were often knocked down by night. The lantern smashing that increasingly erupted during episodes of political unrest, most notably the French Revolution, was but the most dramatic, if short-lived, expression of resistance. As weapons of government surveillance, lamps fell victim in riots from Gothenburg to Milan for both symbolic as well as tactical reasons – rendering recent efforts by modern municipalities to extinguish street lights richly ironic. Set in Paris during the upheavals of 1830, Victor Hugo's *Les Misérables* (1862) contains a chapter entitled "The Street Urchin an Enemy of Light," depicting the lantern-smashing techniques of the orphan Gavroche in bourgeois neighbourhoods. "Along with the réverbères," stated a subsequent account of the first night of the July Revolution, "all other symbols of the treacherous king's authority were destroyed."

### Dreams we have lost

None of this is to minimise, for all social classes, the dangers that darkness often posed, much less to applaud current efforts to restrict urban lighting in financially blighted cities.

Today, no longer are there witches and wolves to fear, but research strongly suggests, as one might expect, the critical value of street lighting as a hindrance to both crime and automobile accidents. One reason for the full-scale removal of metal posts from a Detroit suburb was the fear that they might be stolen if left unlit, notwithstanding the assurances of police that crime rates, as a consequence, would not rise. Certainly in the developing world, public lighting, we should not be surprised to hear, remains highly coveted by millions still bereft of electricity.





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Already, the fanciful world of our dreams has grown more distant with the loss of segmented sleep and with it, a better understanding of our inner selves.

All the same, it is impossible not to feel a deep pang of regret over the present trajectory of technological change in the absence of greater efforts to curb light pollution. Increasingly, rather than rendering night-time more accessible, we are risking its gradual elimination. In the early 1990s, the Russian government even attempted to launch an experimental 'space mirror' designed to transform night into twilight in selected northern latitudes with the aid of reflected light from the sun. (Not all potential beneficiaries, including many Canadians, welcomed the prospect.)

Alternating cycles of darkness and light, regular respites from the daily round of sights and sounds – all will be impaired by unregulated illumination. Ecological systems, with their own rhythms of nocturnal life, will suffer immeasurably. With darkness diminished, opportunities for privacy, intimacy and self-reflection will continue to grow more scarce. Among those to recognise the mixed consequences of street lighting was the American philosopher Ralph Waldo Emerson in observing, "As gas light is found to be the best nocturnal police, so the universe protects itself by pitiless publicity."

Already, the fanciful world of our dreams has grown more distant with the loss of segmented sleep and with it, a better understanding of our inner selves. By the early twentieth century, the bifurcated sleep of our forebears, separated by an interval of wakefulness in which to ponder nocturnal visions, had grown compressed and consolidated, largely due to the impact of later bedtimes and the physiological impact of artificial illumination upon the human body clock.

With the transition to a seamless pattern of slumber, countless numbers lost touch with their dreams and, as a consequence, a traditional avenue in the still darkness to their deepest emotions. By turning night into day, modern

technology, capable of penetrating the inner recesses of the brain, has helped to obstruct our oldest path to the human psyche – "disannulled of our first sleep," to paraphrase an early poet, 'and cheated of our dreams and fantasies.'

In the meantime, the heavens, our age-old source of awe and wonder, have been obscured by the glare of outdoor lighting. As will the immensity of night, which even today for those in remote retreats yet confers a pronounced sense of personal sovereignty. Historically, it has been the heavens, after all, that have invited mortals' grandest visions. Night traditionally knew no bounds. Goethe, on a moonlit evening in Naples, felt "overwhelmed," as he put it, "by a feeling of infinite space." And not just poets and philosophers. As an English labourer in the eighteenth century exclaimed as he trod home from an alehouse, "Would I had but as many fat bullocks as there are stars." To which, replied his companion, "With all my heart, if I had but a meadow as large as the sky." Today, no modern opponent of light pollution could put the case more passionately.

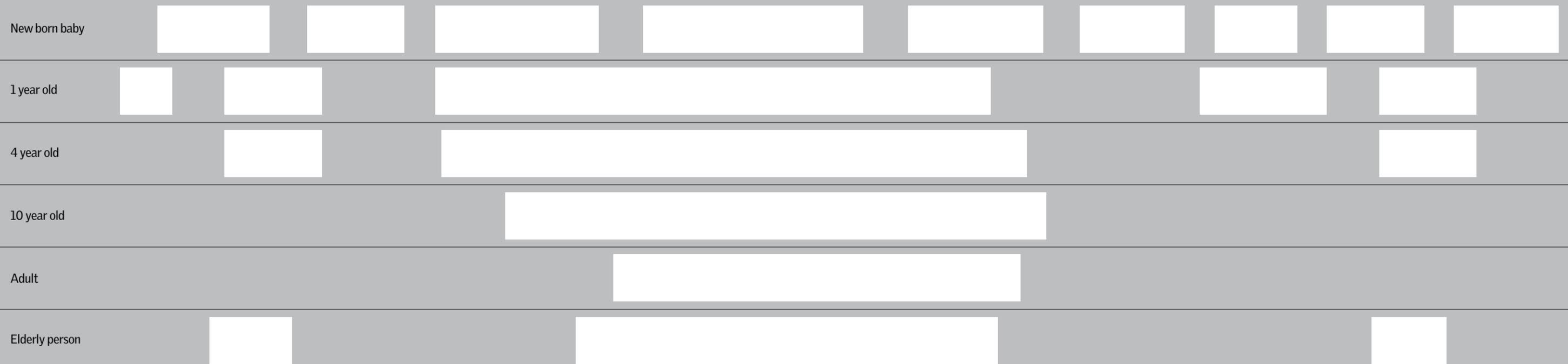
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**A. Roger Ekirch**, PhD, is an award-winning author and professor of history at Virginia Tech in the USA. His research focuses on early North America and the British Isles but also includes the history of sleep – on which he wrote at length in *At Day's Close: Night in Times Past* (W.W. Norton: New York, 2005), from which excerpts have been included in this article.

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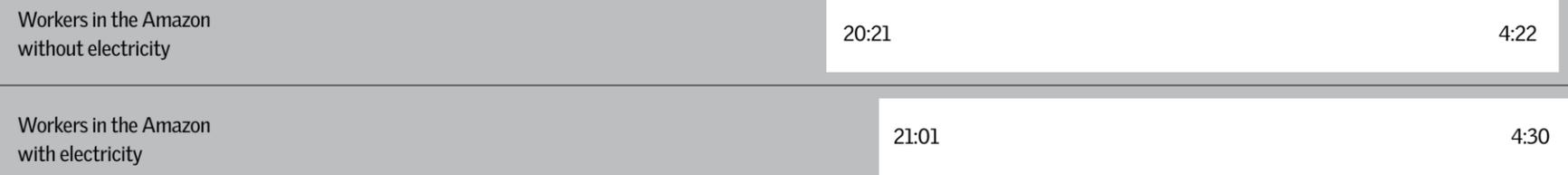
### Sleep and age



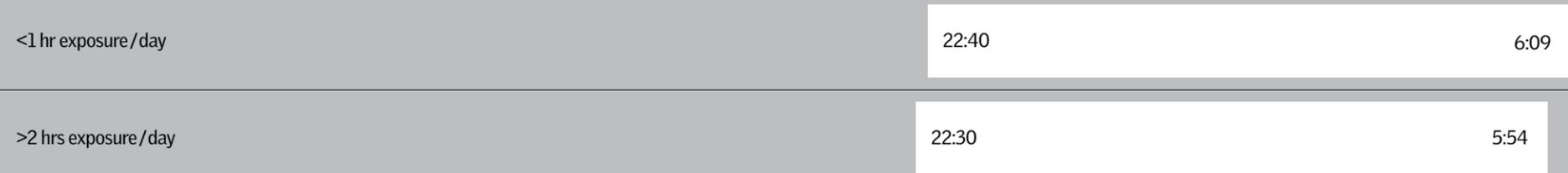
### Sleep throughout the ages



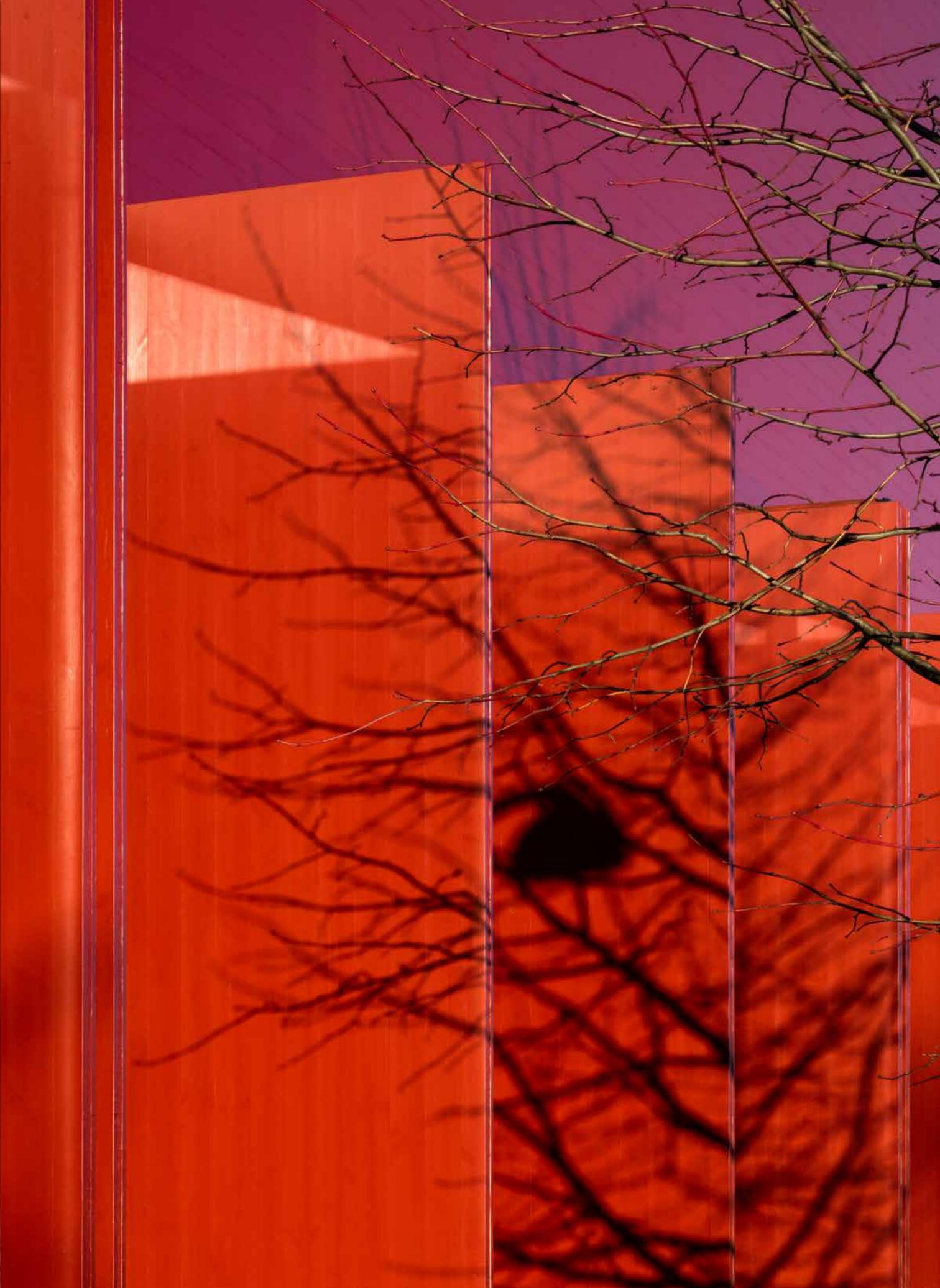
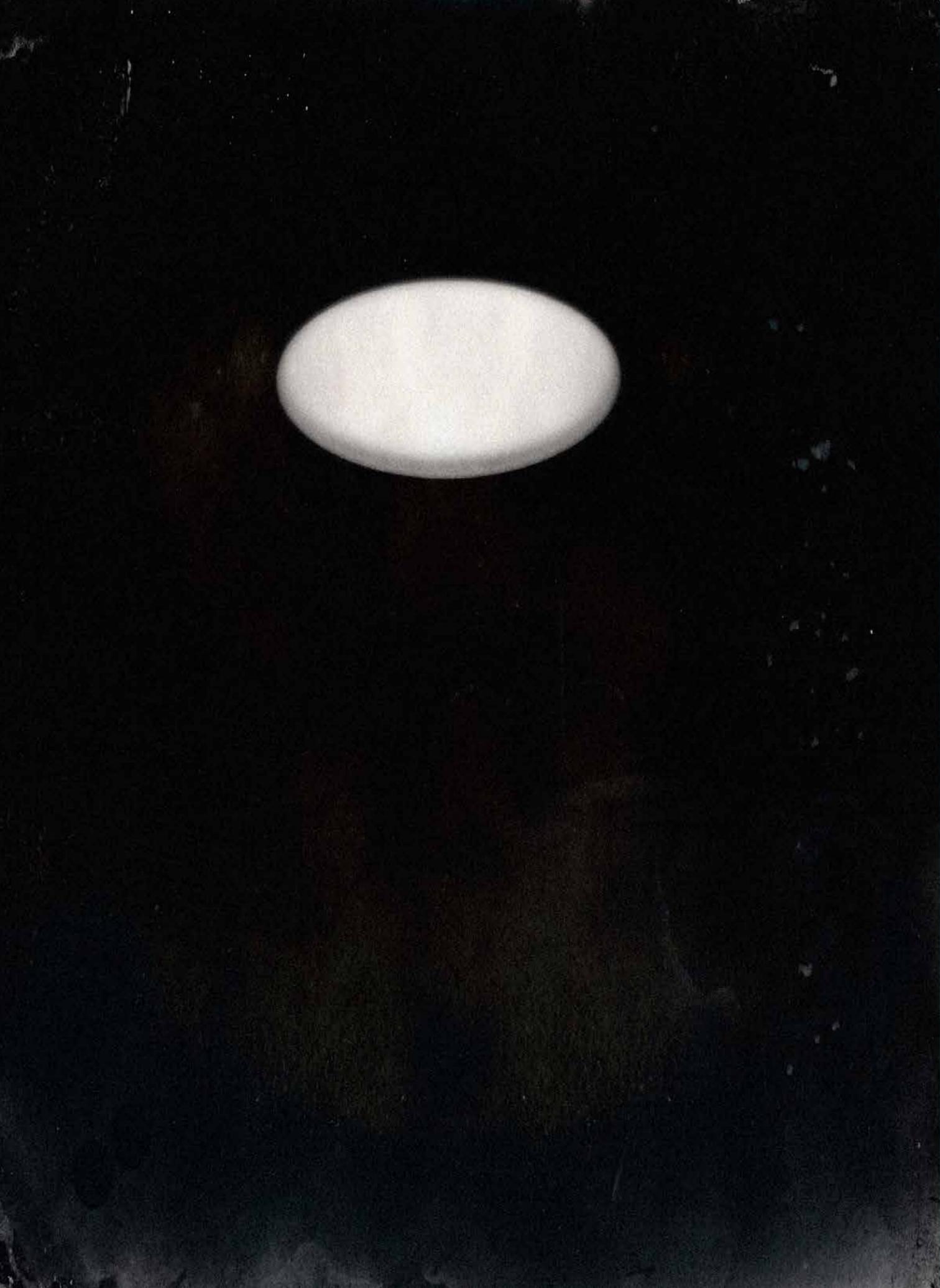
### Influence of light at night



### Influence of daylight



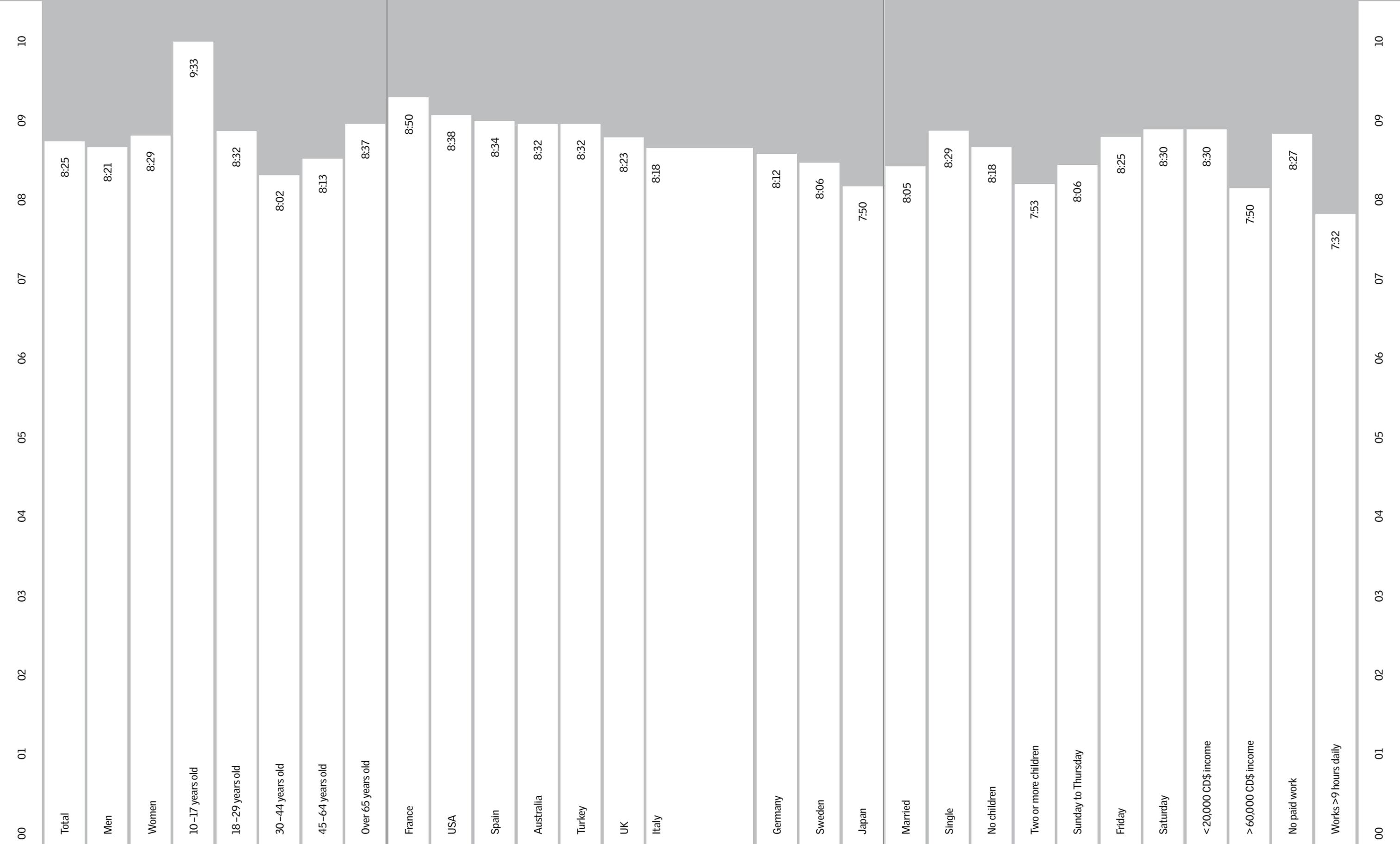
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Sleep duration for different age groups  
(German survey 2013)

Sleep duration in different countries

Sleep duration under different circumstances  
(Canadian survey 2005)





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# NIGHT AND SLEEP – A BRIEF OVERVIEW

Like one third of all mammals, human beings have evolved to be active during the day and sleep at night. However, our sleep patterns have changed significantly over the centuries and also vary considerably between different age groups. In industrial times, the availability of light at night has probably had the greatest influence on human sleep, as is shown in the brief overview below.

*By Jakob Schoof*

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## WHY DO WE SLEEP?

We need sleep for three reasons: to save energy, to stay healthy and to remember things. During sleep, the energy expenditure of the body and brain is reduced and new energy deposits build up in the brain.

Furthermore, many functions of our immune system are at their most effective during sleep. Growth hormones are mainly produced during the first half of night sleep, so that the production of new body and brain cells peaks at night. Lastly, during sleep our brain has a chance to go through the information received during the day once again and store a fraction of it into the long-term memory.

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## ... AND WHAT HAPPENS IF WE DON'T?

Sleep-deprived people show cognitive deficits (around 25% in those with chronically disturbed sleep) and their immune system is often weakened – to the point that they run a higher risk of developing cancer and other chronic diseases. Insufficient sleep may also lead to obesity, as our body tends to overcompensate the extra energy expense for staying awake by an increased calorie intake.

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## WHY DO WE SLEEP BEST AT NIGHT?

Under the influence of the natural light-and-dark cycles, both the core body temperature and the melatonin level in our blood tend to be at their minimum at night. Therefore it is much easier to fall (and stay) asleep at night than during the day. The body temperature drops to its lowest level between 2 and 4 a.m. After this time, people experience fewer periods of deep sleep and can be woken up more easily and, once awake, find it harder to fall asleep again.

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## HOW LONG SHOULD WE SLEEP?

Large-scale surveys have shown that people who sleep 7–8 hours on average live longest. The statistical life expectancy is reduced for people sleeping shorter or longer. Also, short sleepers (<6 hrs) and long sleepers (>8 hrs) run a slightly greater risk of getting a stroke.

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## WHEN DO WE SLEEP?

Human sleep patterns vary with age. New-born babies usually go through 5–6 phases of sleep each day, and wake up approximately every four hours. After one year, night-time sleep has usually consolidated, and sleeping during the day is limited to two short naps. As children grow older, their night-time sleep tends to get longer and napping becomes increasingly rare. 25- to 40-year-olds usually have the shortest sleep times. Retired people often return to the practice of napping after lunch, also to make up for the fact that they often experience night-time sleep to be less deep than younger people. Overall, in a survey in England, 37% of males and 25% of females reported napping during the day.

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## HOW DOES LIGHT AT NIGHT AFFECT SLEEP?

Having electric light at our disposal makes us go to bed later. In a study among workers in the Brazilian Amazon basin, researchers compared the sleeping times of those who had electric light in their dwellings with those who relied only on natural light. On average, the workers who followed the natural light/dark cycles went to bed 40 minutes earlier and slept half an hour longer than the other group.

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## ... AND LIGHT DURING THE DAY?

People who are exposed to longer periods of daylight (>2 hours per day) need shorter sleep and go to bed slightly earlier than those who do not. This was shown in a survey of over 15,000 people in Sweden. For comparison, a Canadian study in 1998 revealed that an average person stays outdoors 0.4 hours in winter and 2.6 hours in summer.

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## THE "WINTER BLUES"

Lack of daylight is not only correlated with sleep problems but also with lowered mood and the occurrence of seasonal affective disorder (SAD). In the Swedish study already mentioned, self-rated health was particularly lowered among the group with low daily exposures (<30 min) to daylight. Statistically, every additional half-hour of daylight will reduce the risk of poor sleep and mood disorders by 33%. The highest risk was found among young females who take no regular bodily exercise.

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## SLEEP AND SEASONAL RHYTHMS

In pre-industrial times, human sleep patterns used to follow the availability of natural daylight. Particularly in winter, people took on a habit of two-part sleep, with the first period lasting from 8 pm until around midnight, and the second one from 2 am to wake-up time.

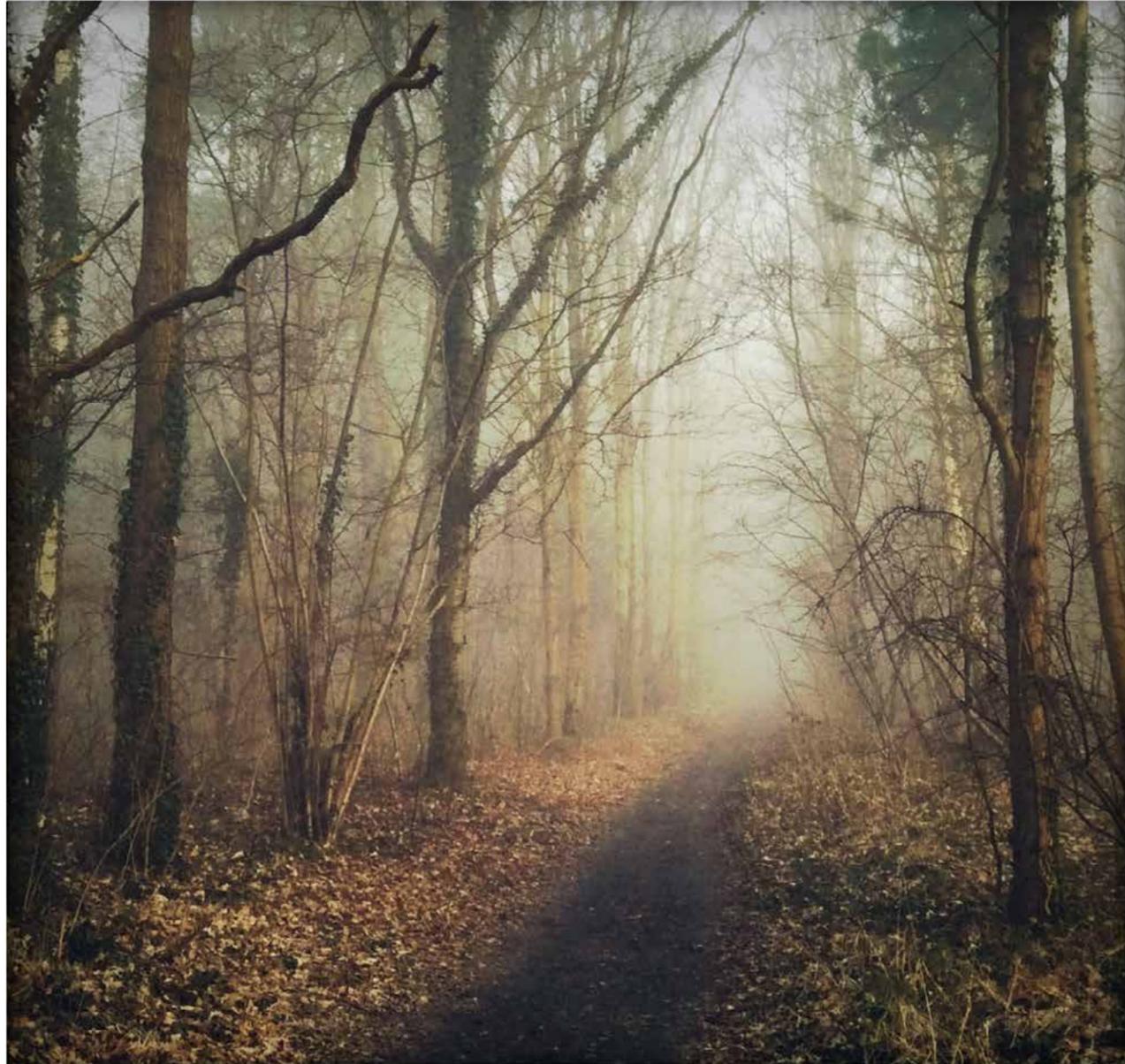
Today, sleep has been compressed into one (roughly) seven-hour period. Among the German population, the average bedtime is 11:08 pm, and people get up on average at 06:18 am.

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## HOW LONG DO WE SLEEP?

Studies from different countries consistently show that, on average, women sleep slightly longer than men, and that the duration of sleep is longest for people under 20. On weekends, people catch up on the sleep they missed out on during the week. According to statistics, people with long working hours, high wages, and one or more children sleep less than the average population.



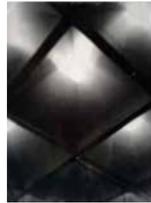




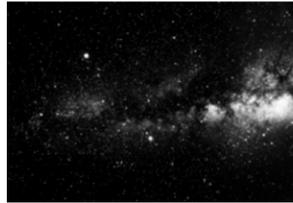
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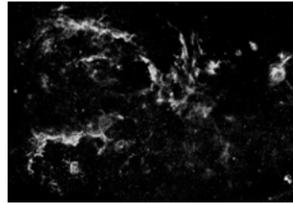
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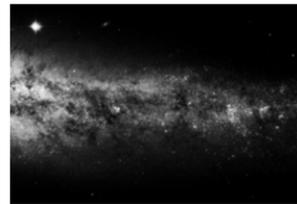
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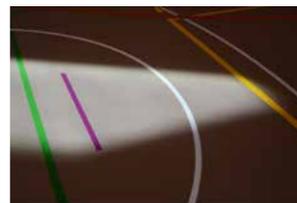
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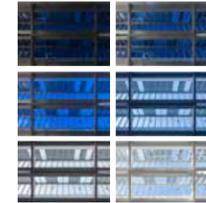
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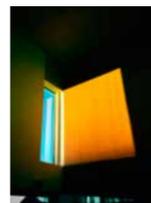
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**DAYLIGHT & ARCHITECTURE**  
**MAGAZINE BY VELUX GROUP**  
SPRING 2016 ISSUE 25

Publisher: VELUX Group, Michael K. Rasmussen  
VELUX Editorial team: Per Arnold Andersen,  
Christine Bjørnager, Lone Feifer

Editorial & creative advisor: Torben Thyregod  
Editor: Jakob Schoof/DETAIL  
Photo editor: Torben Eskerod  
Art direction & design: Stockholm Design Lab ©  
Per Carlsson, Björn Kusoffsky, Christopher West

Translation: Sprachendienst Dr. Herrlinger,  
Sean McLaughlin, Jakob Schoof  
Proof-reading: Tony Wedgwood

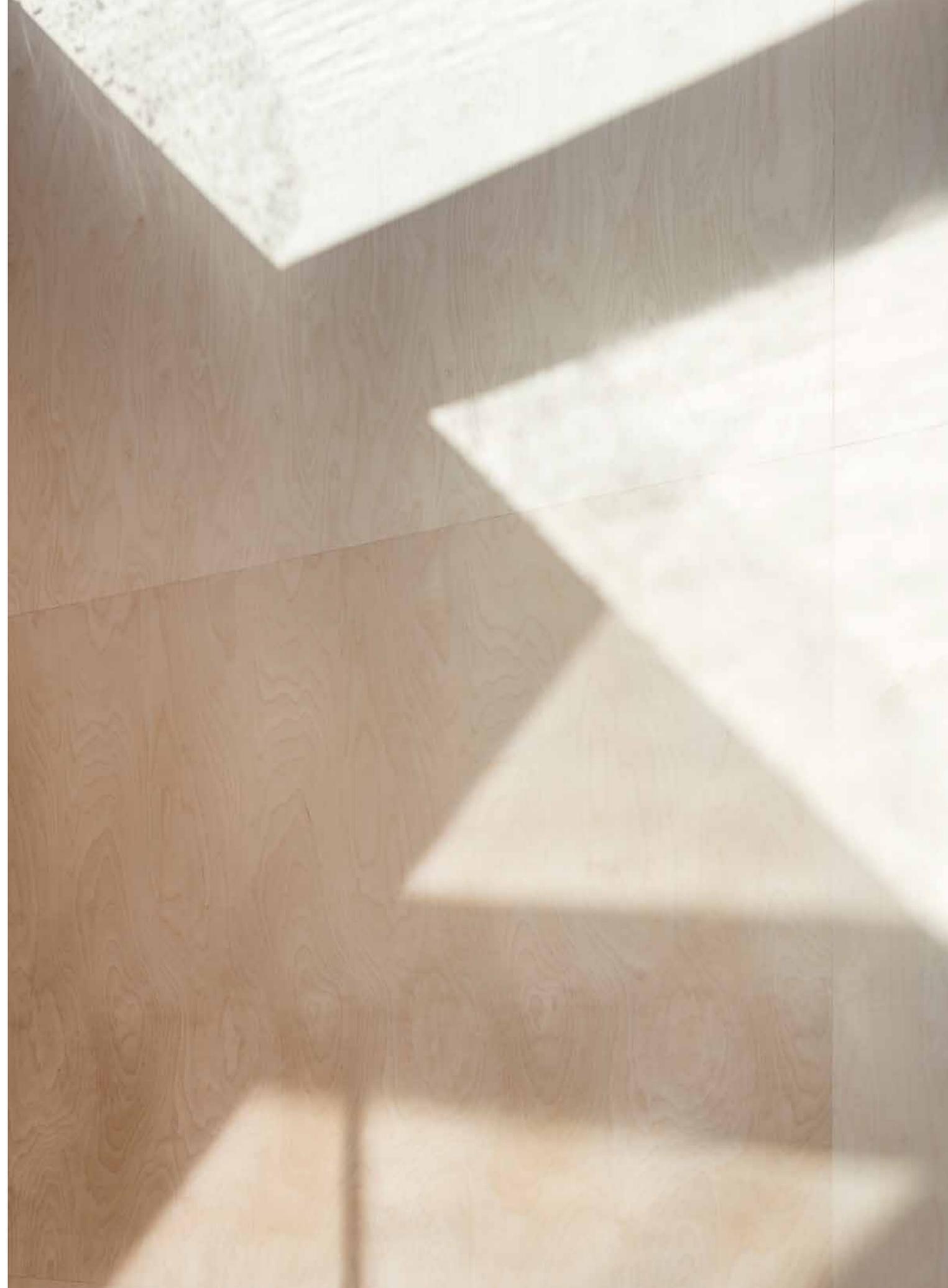
Front, back and inside back cover photography  
by Adam Mørk  
Inside front cover photography by  
Daniel Blaufuks

Print run: 23,000  
ISSN 1901-0982

The views expressed in articles appearing in  
Daylight & Architecture are those of the authors  
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