Night for Day: From UV Flooding to IR Drought

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INTRODUCTION

Day for night, also known as La Nuit Américaine (American night), is the name given to cinematographic techniques used to simulate the night while filming in daylight. These production techniques include using tungsten-balanced rather than daylight-balanced film stock, special CTB filters, and infrared films, or they involve under-exposing shots by three stops. These techniques create the illusion of darkness or moonlight, and they are close to the effect of indirect sunlight.

Sunlight, or the radiation from the Sun, is a mixture of electromagnetic waves ranging from infrared (IR) to ultraviolet (UV) rays. Daylight is the combination of all direct and indirect sunlight during daytime. Artificial light enables activities normally conducted in daylight to be continued into the night. Most of these open-air activities unfold on land, in such places as construction sites or playground areas, whose appearances are transformed into vague landscapes with an intense reddish hue through incandescent and mercury-vapour lighting, which operates beyond the red visible channel.

In photography, a negative is an image in which the lightest areas of the photographed landscape appear darkest and the darkest areas appear lightest.

When we use the colour negative of landscape photography, we take into account values beyond the immediate perception of the cultural landscape and emphasize what remains hidden in the direct capture. Traditionally, thermal photography easily reveals humans and other warm-blooded animals visible against cooler environment. But landscape is not a cooler environment due to its natural and artificial flows of movement, in as aquifers and subterranean rivers, or water and power lines, respectively.

While diurnism involves the cinematographic technique used to simulate night during the day (day for night), noctambulism—beyond the meaning of sleepwalking—involves artificially extending the day during the night (night for day). For example, when we compare a colour positive picture of the land and the sky of the port of Barcelona in relation to a colour negative picture taken in the Concha beach of San Sebastián, both taken at night, the final visual appearance of these images is the same. But the sea of both colour positive pictures remains the same at night, so we do not need to make negative prints.

The reason why both the positive and the negative pictures of the sky and the land in the coastal area look similar is the excess lighting in Barcelona. Surrounded by fluorescent lights, the sea remains practically unchangeable during the night, and does

not seem to be affected by the endless artificial day of the city, which offers a permanent fireworks display. Light behaves very differently when it moves from air into water, becoming polarized, which means its waves vibrate in only one direction, or plane. The main colour of the surface belongs to blue spectrum, while the deep sea regions approach the UV spectrum. However, there are changes in the deep sea as recent ozone changes allowing UV light to penetrate the upper 200 metres may be occurring too fast for marine organisms to adapt during daytime.

The question is: how might we create a new version of the day-for-night state, one that creates night during the day, in order to recover the benefits of the dark, to discover beauty in the colours countless built-up layers of darkness. To do so would also avoid the excessive use of energy required for urban lighting, as a hypothetical technique—night for day—would be used to simulate a day scene while filming in night light.

Land changes appearance at night, with the colour and texture of its minerals becoming more pronounced, and the built environment fades to nothing. The Earth's minerals become the main components of fireworks: sodium, barium, strontium, copper, and magnesium. The reason for using negative process in digital photography today is to divert attention away from landscapes as merely cultural constructs and rather focus on their strategic capability to secure survival. For example, when we reverse the image of NASA's World Map of Night Lighting, we find that the dark areas match drought áreas, which harsh conditions do not allow isolated settlements to develop electrical infrastructure, using coal and wood for heating and cooking, that results in deforestation and soil erosion.

Maybe because the sea is often ignored amidst the artificial daylight that dominates the night, we forget its immense power. A power that can lead to rise in sea level which, even if small, are enough to cause thousands of coastal inhabitants to flee to safe havens, or ships to sink. Conversely, the overexploitation of land and the tight control of water in the city, where it disappears from view through a myriad of water and sewage networks without the possibility of taking advantage of soil porosity and aquifer recuperation, is causing the opposite effect—desertification. When thinking of public investment in infrastructure, it is important to note the close relationship of electricity networks to water resources, and consider the need for electricity for both the real and virtual worlds. As Brian Thomas Carrol has noted, "cyberspace ceases to exist without electricity."[1]

These two possibilities—flooding and drought—can be reversed or rendered positive, depending on the balance which may be found between the land and the sea. Nowadays, for example, there are special agreements over coastal defenses, new "energy islands" in Norway, and waterfronts with disinfection and desalinization plants in Riyadh. Additionally, regarding energy efficiency light emitting diodes as a form of light visible communication (OWC) instead of radio frequency waves converts the light into digital information and is so far measure 10.000 times larger than radio waves. As well as a subset of optical wireless communication technologies, Li-Fi networks and thermal scanners in Estonia show how international solidarity and collaboration might establish new dynamics of protection.

FROM DAY FOR NIGHT (COLD) UV CINEMATOGRAPHIC TECHNIQUES

The Sun emits ultraviolet radiation at all wavelengths, including that of extreme ultraviolet, where it becomes x-rays at 10 nm (nanometres). Extremely hot stars emit proportionally more UV radiation than the Sun. The quality and quantity of sunlight radiation thus depend on atmospheric conditions. The following description of several types of electromagnetic radiation introduces the fact that each light radiation—ultraviolet, RGB canals and infrared—can be used in a different way to to help emergency situations.

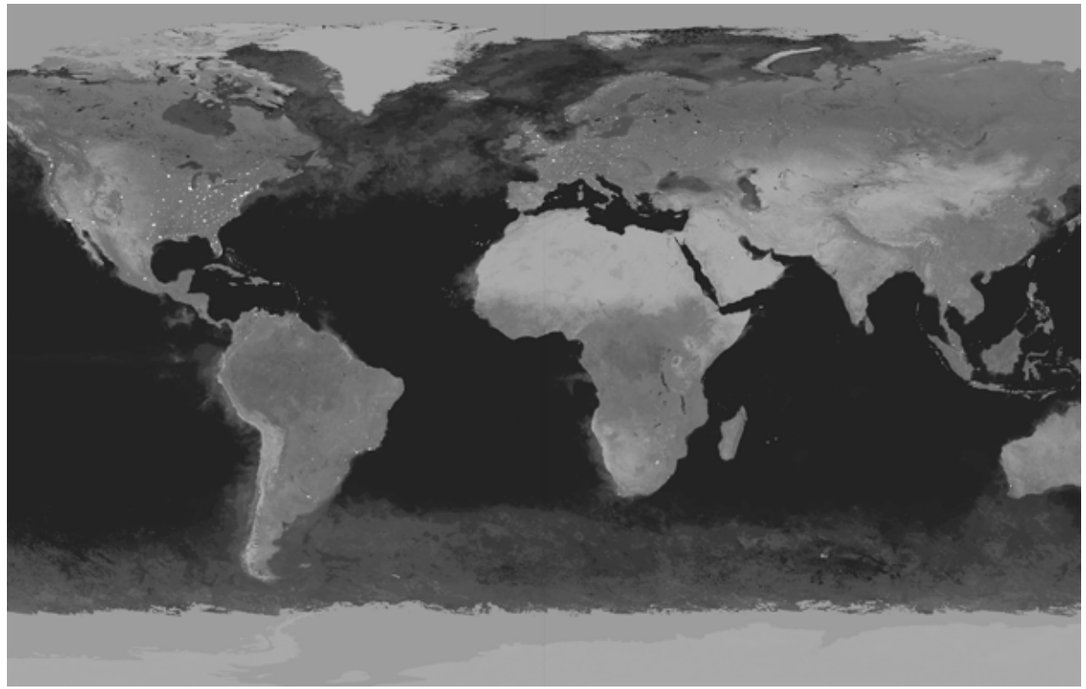

Fig 1. World Map of Night Lighting (positive). Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC.

Types of Electromagnetic Radiation: Ultraviolet, x-ray and gamma spectroscopy.

1. Near UV (200–380 nm)

Near-UV (NUV) is visible to some insects, birds, and fish. The short wavelength allows for precise focusing and the generation of very fine structures; it is thus used in UV photolithography, which serves in the fabrication of microelectronic devices such as microprocessors and memory chips. The use of a Baader Venus filter allows for the detection of wavelengths between 300 and 400 nm; the human eye has nearly no sensitivity in this range, but charge-coupled device (CCD) sensors do. The filter completely blocks the rest of the spectrum, from 200nm to 1500nm.

1.1. Near-ultraviolet A (315–400 nm) – Luminescence. UVA is a long-wave form of black light, which is not absorbed by the ozone layer. Special UV lamps known as Black Light fluorescence tubes or bulbs can be used for long-wave ultraviolet photography. Giving attention to the water purification and biomass production, the addition of UVA radiation to photobioreactors, while retaining cell visibility, can be successfully applied to long-term carotenoid production processes where plants and algae absorb light energy for use in photosyntesis.[2] Curing involves the cross-polymerization of a photosensitive material, which can be an ink, adhesive, or coating and when additives are activated by ultraviolet radiation, the process is called UV Cure as a way of hardening building materials in emergency situations. Connected with these long-wave forms of black light, there is a technique that uses Baader-U filters, black light fluorescent, incandescent and mercury lamps in order to darken the picture.

Day for night cinematography. Some techniques can create the illusion of darkness. Historically, infrared film stock was used to achieve a look equivalent to darkness in black-and-white film. Nowadays, with digital post-production techniques it is also common to add or intensify glare and light shattering from sources that would otherwise be less pronounced in daylight, such as car headlights, windows showing indoor lighting, or outdoor artificial lamps. There are several techniques for making day-for-night in pre-production, production, and post-production phases.

1. Pre-production (camera)	2. Production (lights)	3. Post-Production (computer)
Tungsten-balanced film stock	Artificial tungsten lights	Dimming of images
Infrared film	Mercury-vapor lamps	Digital infrared effect
Camera's white balance set to tungsten	Tanning bulbs	Blacklight effect
Under-exposed light by one to three-stops	Black lights (fluorescent, incandescent and mercury lamps)	The blending of channels, red and potentially green
Blue cover lens	Blue gel CTB	
Baader-U Venus or Precision-U filter	Baader-U filter	
Hitech or Hoya R72 infrared filter	Polarizing filter	

In 2001: A Space Odyssey (1968), Stanley Kubrick filmed the ghostly night scenes in the "Dawn of Man" sequence using basically the same techniques that are routinely employed for shooting day-for-night exteriors in the true outdoors. He under-exposed the film by one or two stops and printed it through a light blue filter. And François Truffaut's well-known 1973 film La Nuit Américaine (1973) refers to this process in its title and makes it a central part of its plot.

Several films give us days without nights. One of the first, Fehér éjszakák (White Nights, 1916), was directed by Alexander Korda and was an adaptation of Victorien Sardou's play Fedora, with Lili Berky in the title role. Luchino Visconti filmed Le Notte Bianche (White Nights) (1957), an adaptation of a Dostoevsky story, with Maria Schell and Marcello Mastroianni as the principal actors. Finally, Taylor Hackford directed another film with the title White Night (1985), starring Mikhail Baryshnikov and Gregory Hines. The term "White Night," with its suggestion that the darkness of the night has been deleted, names other things as well: a night in which one lies sleepless in bed, and the all-night art festival (Nuit Blanche) held in many cities around the world. In addition, Mohsen Mostafavi's edited volume Ecological Urbanism contains an article called "Old Dark" (2010), about a man named Joe Stilgoe who claims to have switched off the lights and lives solely in the dark.[3]

In Cenotaph for Newton (1784), in a scenography of this day-for-night technique, Étienne-Louis Boullée imagined a spherical interior world that inverts exterior lighting conditions. During the day, a black starlit night blanketed the interior with points of light that penetrated the thick shell through narrow punctures whose arrangement corresponded to the locations of planets and constellations. During the night, light radiated from an oversize luminaire suspended at the centre point of the sphere, resulting in a vaguely celestial form whose light spilled through the long entry tunnels.

In Night World (1979), Bernard Goldberg proposed a night city for a large-scale fantasy playground in central Florida, near the Walt Disney World Resort, involving a circular design in an artificial lake. The main focus of the proposal was a nighttime entertainment centre and alternate venue for people who visited Disney World during the daytime. The water area was laid out as a vast circle defined by curving lines and fluid spaces punctuated

by tent structures, the latter consisting of four main facilities with separate domes for cabaret, movies, and theatre, as well as shops, exhibits, and television studios. The Cabaret Dome recalled Claude-Nicolas Ledoux's 1775 design for the Théâtre de Besançon, while the Automobile Spiral featured a suspended mast structure.

1.2. Near-ultraviolet B (280–315 nm UVB) — Leafty vegetable growth. UVB is medium-wave, and mostly absorbed by the ozone layer. The application of UVB accelerates the production of polyphenols in certain vegetables, such as red lettuce. It is also used in curing inks, medical light therapy, forensic analysis, and pharmaceuticals.

Ultraviolet photography. This is the process of recording images using only light from the ultraviolet spectrum. This type of signal gets spread amongst the RGB channels due to the Bayer filter array, whose blue channel is where most of this signal ends up. UV radiation is present in sunlight, and produced by electric arcs and specialized lights such as electronic flashes with aluminum reflectors, mercury vapor lamps, tanning lamps, black lights, and UV LEDs. There are two ways to use UV radiation to take photographs:

1. Reflected ultraviolet photography. The subject is illuminated directly by UV-emitting lamps or strong sunlight, and a UV transmitting filter is placed on the lens, which allows the ultraviolet channel to pass and which blocks all visible and infrared light (the Baader-U filter and the Precision-U filter on the lens). For UV photography it is necessary to use specially developed lenses containing elements made from quartz and fluorite.

2. Ultraviolet-induced fluorescent photography. The light goes directly to the object from UV-emitting lamps or sunlight, and a UV absorbing filter is placed on the lens, which blocks all ultraviolet and infrared light and permits only the visible radiation to pass. When the shorter and higher ultraviolet wavelengths are absorbed, the UV light loses some energy and is emitted as lower-energy visible wavelengths; a visible fluorescence is produced in a suitable object.

In Nuclear Waste Encapsulation and Storage Facility (2008), Taryn Simon took a picture of 1.936 stainless-steel nuclear-waste capsules submerged in a pool of water at Hanford Site. She writes about the blue glow created by the Cherenkov Effect, which designates the electromagnetic radiation emitted when a particle of spent fuel moves faster than light through a transparent medium, giving off energy. Unlike fluorescence or emission spectra, which have peaks, this radiation is continuous. In fact, the Cherenkov effect is in the ultraviolet spectrum, and it is only with accelerated changes that it even becomes visible, because the sensitivity of the human eye peaks at green and is very low at the violet portion of the spectrum.

1.3. Near-ultraviolet C (200–280 nm). Air/Water sterilization and surface disinfection. UVC is short-wave, germicidal, and completely absorbed by the ozone layer and atmosphere. In the UV-C light spectrum (200-280 nm), the wavelength around 254 nm has been proven to be the most efficient wavelength for rendering microorganisms inactive by damaging nucleic acids, this disrupting an organism's ability to replicate. UV Germicidal Irradiation can be used to disinfect air with prolonged exposure.[4]

2. Far UV (190–220 nm) / Vacuum UV (40-190 nm V-UV) - Odour removal. The far ultraviolet (FUV) lies between the near and extreme ultraviolet regions, and is the least explored of the UV radiation types. Vacuum UV (V-UV) is produced between 100 and 200 nm, and propagates only through a vacuum since it is otherwise readily absorbed by the air. Generated naturally by short-wave solar ultraviolet radiation, Ozone appears in our upper atmosphere ozonosphere in a form of a

Fig. 2. Ripon: Summer Cumuli. From Charles Piazzi Smyth, The 1890s Clouds Photograph Albums (1892–1895).

gas and also may be produced naturally passing an electrical discharge—such as lighting—through oxygen molecules. Ozone readily combines with other molecules and is thus used to oxidize molecules and remove odours.

3. Extreme UV (1–31 nm / EUV or XUV) – Compact lasers. Extreme ultraviolet (EUV) is the ultraviolet light closest to X-rays, and is the most energetic of the UV radiation types. There are some applications, for extreme ultraviolet wavelengths (5 to 50 nm), such as compact lasers that can focus onto microscopic areas. These offer new potential for the imaging, patterning, and manipulating of objects, due to their short wavelengths and energetic photons.

THROUGH DAY FOR DAY PHOTOGRAPHIC TECHNIQUES (RGB)

Visible light is usually defined as having wavelengths in the range of 400–700 nm, between the infrared with longer wavelengths and the ultraviolet with shorter wavelengths. Visible Light Communication (VLC) is a medium that uses visible light between 450-800 nm, and is a subset of optical wireless communication technologies. This technology uses fluorescent lamps to transmit signals at 10 kbits/s or uses light emitting diodes, LEDs, lamps for up to 500 mbits/s.

Electromagnetic Radiation: Visible Spectroscopy

Analog photography: This uses the gelatin process, with light falling upon photographic emulsions containing silver halides, recorded as a latent (negative) image. After this latent image is subjected to photographic processing it is turned into a visible (positive) image. Photographic processing first starts with the exposure process involving photographic film inside the camera. Second, a chemical process involves subsequent treatments using a developer, stop bath, and fixer. In addition to its use as a developer, silver salt is the most common chemical used for cloud seeding in order to disperse a substance into the air that may serve in the formation of clouds or ice nuclei.

1. Blue (450—515-520 nm / B) - Atmosphere & Deep Water (50m)

Visible blue light has a wavelength of about 475 nm, is used for atmospheric and deep water imaging, and can reach depths up to 150 feet (50 m) in clear water. Blue wavelengths are shorter in the visible spectrum, so they are scattered more efficiently by molecules in the atmosphere and for that reason the sky appears blue. Although moonlight is not actually blue, it appears bluish to the human eye due to the Purkinie effect, or dark adaptation, which is the tendency for

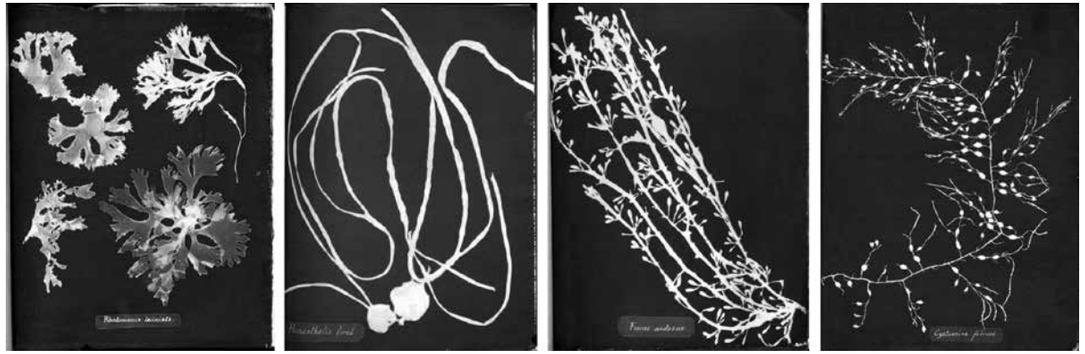

Fig. 3. Plates from Anne Atkins, British Algae: Cyanotype Impressions, 1843

the peak luminance sensitivity of the human eye to shift toward the blue end of the colour spectrum under low illumination conditions.

In The 1890s Clouds Photograph Albums (1892–1895), Charles Piazzi Smyth visualized scientific information by taking sequential shots of clouds. Each image was accompanied by precise details about the photograph, as well as weather information and other observations of thermodynamic parameters. Smyth was an astronomer, surveyor, meteorologist, pioneer, artist, traveler, and photographer. In the 1870s he designed and constructed a camera with a lens of 1.7’ in diameter and a 14’ focal length to produce images on small glass plates. He proposed the use of photography as a serious tool for his meteorological research into a number of conditions, such as low barometric pressure, low temperature, heavy-spectrum rain-bands, various wind directions, abundant atmospheric electricity, and strong winds.[5]

2. Green (515-520—590-600 nm / G) - Vegetation & Medium Deep Water (30m).

Green is used for imaging vegetation and deep-water structures up to 90 feet (30 m) in clear water. Visible green light has a wavelength of about 510 nm. Vegetation appears green because all of the colours in the visible part of the spectrum are absorbed into leaves except green, which is reflected back. The Bayer filter mosaic is a colour filter array (CFA) for arranging RGB color filters on a square grid of photo sensors. This filter uses twice as many green elements as red or blue to mimic the physiology of the human eye; during daylight vision, the luminance perception of the human retina uses M and L cone cells combined, which are most sensitive to green light.

In Photographs of British Algae: Cyanotype Impressions (1843), Anne Atkins, an English botanist and photographer, recorded plant specimens for a scientific reference book, placing them directly on top of sensitized paper. This was one of the first uses of light-sensitive materials to illustrate a book. She learnt the cyanotype printing process from its inventor, astronomer and scientist Sir John Herschel.

3. Red (600-630—680-690 nm / R) – Soil & Low Deep Water (9m)

Visible red light has a wavelength of about 650 nm, and is used for imaging man-made objects, in water up to 30 feet (9 m) deep, soil, and vegetation. At sunrise and sunset, red or orange colours are present because the wavelengths associated with these colours are less efficiently scattered by the atmosphere than the shorter wavelengths of blue and purple. The insensitivity of rods to long-wavelength light has led to the use of red lights under certain special circumstances—for example, in the control rooms of submarines,

Fig. 4. Solar effect in the clouds and ocean. Gustave Le Gray, Sea and Sky Photographs (1856–1857).

research laboratories, aircraft, and during naked-eye astronomy.

In Sea and Sky: Photographs (1856–1857), Gustave Le Gray took photos when the sun was down and clouds casted dark shadows on other clouds; his dark seascapes were often mistaken for moonlight. The difficulty of taking photos of the sea and clouds at the same time is due to high light intensity. In "The Great Wave, Sète" (1857), he photographed the Mediterranean coast near Montpellier; at the horizon the clouds are cut off where these clouds meet the sea, due to the need to splice two negatives together, the union of which allowed him to achieve tonal balance between the sea and the sky. Le Gray's glass negatives were the same size as his photographs, about 32 x 42 cm, and he placed the negative directly on the top of the photographic paper and printed in sunlight. The prints were toned in a solution of gold chloride in hydrochloric acid, resulting in violets and purples.

Fireworks: These need a source of combustible material for energy, such as black powder (charcoal, sulfur, and potassium nitrate) or smokeless powder, such as cellulose nitrate. Colour production in fireworks involves two main mechanisms:

1. IR Incandescence (the light is produced from heat). This initially results in the emission of infrared light, and then red, orange, yellow and white light, as the substance (charcoal, aluminum, magnesium, titanium) grows increasingly hotter. Blues and greens require much higher temperatures and so cannot be formed using these methods.

2. UV Luminescence (the light is produced using energy sources other than heat). The coloured flame is a result of electrodes in sodium ions absorbing energy and moving up to higher energy levels and then falling back to their ground state, emitting specific amounts of energy, photons which determine their wavelengths and ultraviolet colour. Examples of luminescence include fluorescence, phosphorescence, and bioluminescence.

The compounds required to produce specific fireworks are:

Blue – Copper and Chloride
Green – Barium and Chloride
Red – Strontium salt and Lithium salt
Yellow – Sodium
White – Magnesium or Aluminum

... TO NIGHT-FOR-DAY (HOT) REMOTE-SENSING TECHNIQUES (IR)

Sunlight (the electro-magnetic radiation from the Sun) hitting the Earth's atmosphere is composed of about 50% infrared light, 40% visible light, and 10% ultraviolet light, for a total intensity of about 1400 W/m2 in vacuum. This value means the energy that reaches the fringe of our atmosphere. Coming through the earth's atmosphere, it is reflected,

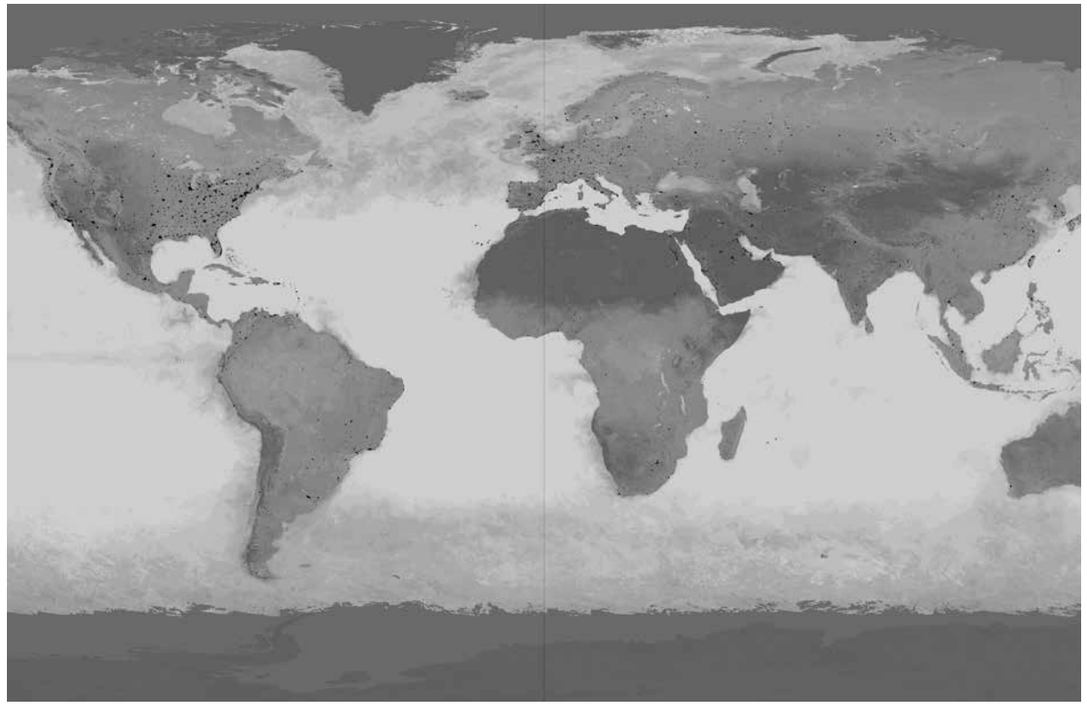

Fig 5. World Map of Night Lighting (negative). Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC.

scattered and absorbed in such a manner that approximately 1000 W/m2 reaches the earth.

Electromagnetic radiation: Near infrared, microwave and radio-wave spectroscopy

Near infrared (750–900 nm) – Vegetation reflexion, transmission and absorption

Near-infrared light is used primarily for imaging vegetation. For example, NASA satellite data can help farmers pinpoint where crops are infested, stressed, or healthy. Rather than studying an object's emission of infrared, scientists can study how objects reflect, transmit, and absorb the Sun's near-infrared radiation to observe the health of vegetation and soil composition.

Infrared photography: In this type of photography, the film, filter, or image sensor used is sensitive to infrared light. The part of the spectrum used is referred to as near-infrared (700–900 nm) to distinguish it from far-infrared, which is the domain of thermal imaging.

The Wood Effect is caused by foliage such as tree leaves and grass strongly reflecting in the same way visible light is reflected from snow. There is a small contribution from chlorophyll fluorescence, but this is minimal and not the main cause of the brightness seen in infrared photographs.

In the Nächte project (1992–1996), Thomas Ruff produced a series of infrared photos shot at night using a camera with the ability to amplify available light, resulting in images of stars, city suburbs, and domestic still life, providing a political and social perspective on the status of images. This type of night photography is associated with the use of multirobots or drones. Thanks to GPS-Position-Hold technology, blur-free images can be achieved, even in strong winds.

2. Mid-infrared Reflexion

2.1. Mid-infrared 1 (1550-1750 nm) - Soil moisture. Mid-infrared 1 is used for imaging vegetation, soil moisture content, and some forest fires.

2.2. Mid-Infrared 2 (2080-2350 nm). Geological features. Mid-infrared 2 is used for imaging soil, moisture, geological features, silicates, clays, and fires.

In La Vie secréte des plantes (2001), Anselm Kiefer made a huge photobook (sculpture, lead, oil, chalk, pigment) 195cm by 300cm and weighing 700kg, with twelve harsh lead paper with sharp ragged edges. The main stars in the Cassiopeia constellation are labeled, and the names of five neighbouring constellations, including Auriga and Perseus, are written in chalk.[6] The title, also written in chalk, refers to Peter Tompkins and Christopher Bird's book, The Secret Life of Plants (1973), which is about the physical and emotional relations between plants, humans and the universe, and in which the authors claim the plant as the universe's guard and healer—and the bearer of its secrets.

3. Far Infrared / Thermal infrared (10400-12500 nm) - Astronomy, water currents and fire emissions

Infrared telescopes. Thermal infrared uses emitted instead of reflected radiation to image geological structures, thermal differences in water currents, and fires. These observations require the use of specially cooled detectors containing crystals made of substances like germanium, which are very sensitive to heat. Infrared radiation, with wavelengths that are much longer than visible light, can pass through the dusty regions of space without being scattered.

Only since the early 1980s has NASA been able to send infrared telescopes into orbit around the Earth, above the atmosphere that hides most of the Universe's light from us. Such devices can detect the very bright stars, and near-infrared light traces the smaller, cooler ones. Far-infrared stars hardly emit any light at all, and instead almost everything we see is generated by the dust clouds themselves, which are cooler than the coldest Arctic night, though still warm enough to emit thermal infrared or far-infrared radiation.

In The Last Pictures (2012), Trevor Paglen sent a photography exhibition into outer space, where it is expected to run for a few billion years. Commissioned and presented by the public-art organization Creative Time, it is a project that places a record of our historical and cultural moment on a spacecraft. For nearly five years, Paglen interviewed scientists, artists, anthropologists, and philosophers to determine what such a cultural record should be. As artist-in-residence at MIT, Paglen worked with materials scientists to develop an archival disc of images capable of lasting in space for billions of years. Paglen's research in experimental geography led to powerful insights into the photographic calibration between the visible and the invisible, such as views of the installation of American military both on the ground and in the air. In different ways, artists like Jill Magid have spoken about systems of secrecy, withholding, obfuscation and opacity, but these were not abstract terms; they were physics. Paglen named indirect ways of seeing and showing secrets in the same way that astronomers had found ways to see and show dark matter.

4. Radar - Landscape and emissions imaging

Radar and related technologies are useful for mapping terrain and for detecting various objects, as electromagnetic wavelengths are longer than infrared light. Radio waves have frequencies ranging from 300 GHz to as low as 3 kHz, and corresponding wavelengths ranging from 1 mm to 100 km. The traditional application of radar is to display the position and motion of typically highly reflective objects such as airplanes and ships by sending out a radio-wave signal, and then detecting the direction and delay of the reflected signal. Imaging radar forms images of a landscape by furthermore registering the intensity of the reflected signal to determine the amount of light scattering. Radar images, scatterometers,

and altimeters provide information on ocean waves, ocean winds, sea surface height, and coastal currents, all of which strongly influence coastal ecosystems.

Nuclear energy. There is a connection between nuclear energy and astronomy. One type of nuclear energy is fusion, which is how stars make energy, the combination of light elements to make heavy elements. The other is fission, the way we produce nuclear energy today, which consists of taking heavier elements and breaking them apart, thereby releasing energy. Both of those are astronomical. Fusion relies on events that took place in the big bang, and fission relies on supernovas, the process that makes neutron stars.[7]

In an ongoing project named Black Square (2006–), Taryn Simon collects objects, documents, and individuals within a black field that had precisely the same measurements as Kazimir Malevich's 1915 suprematist work of the same name. In Black Square XVII (2015–), Simon constructed a permanent space within the Garage Museum of Contemporary Art in Moscow as a concrete wall with a cut-out relief showing where a new piece of the project will reside in the future, alongside a wall text that describes the process and facilities. At the same time, in an active nuclear plant somewhere on the outskirts of Moscow, there is a piece of material which is processing radioactive properties and will do so for the next 1,000 years. Through the vitrification process, Simon has worked to repurpose nuclear waste to create a compound that suitable and safe for disposal. The end result will be a glassy black square which will not be exposed to open air until 3015.

CONCLUSION

By night, when the light spectrum is divided into many bands, it is multispectral rather than panchromatic, which records only the total intensity of radiation falling on each pixel. This process can be used in multispectral video systems, which enables precise information about the objects and their locations to be acquired. When combined with communication systems, it allows for the quick transmission of data in the form of an image, text description, or navigation information in real time. Each light spectrum can be used in a different ways to help in emergency situations, such as floods or droughts. Even the use of mono-frequency lamps can transform the visual field around the sun into a duotone landscape. These lamps emit light at such a narrow frequency that colours other than yellow and black are invisible. The wavelengths may be separated by filters or by the use of instruments sensitive to particular wavelengths, including light from frequencies beyond the visible light range such as infrared or ultraviolet. Spectral imaging, which was originally developed for space-based imaging, can allow for the extraction of additional information that the human eye fails to capture with its receptors for red, green, and blue.

1. Ultraviolet Flooding Luminiscence (cold)

Luminescence: This refers to the emission of light by a substance, not resulting from heat, and a form of cold-body radiation. Bioluminescence is the natural production of light by chemical reactions within an organism, whereas biofluorescence is the absorption and reemission of light from the environment.

1. Fluorescence. As molecules may drop down into any of several vibrational levels in the ground state, the emitted photons will have different energies, and thus frequencies. Bio fluorescent light can only be produced and seen by humans while the organism is being illuminated by an external source, such as a white or ultraviolet light bulb (UV).

2. Phosphorescence. This is a process in which energy in a substance is released relatively slowly in the form of light. As the energy-state transitions occur very slowly in certain materials, absorbed radiation may be re-emitted at a lower intensity for up to several hours after

the original excitation. The study of phosphorescent materials led to the discovery of radioactivity in 1896.

3. Bioluminiscence (UV-A). Some living things can light up dark places without help from the Sun, using a chemical reaction to glow at night, in caves or, most frequently, in the black depths of the ocean. About 80 percent of bioluminescent organisms, such as bacteria, and marine vertebrates and invertebrates, live in the deep sea, while others are terrestrial invertebrates like fireflies. They are able to emit light, showing how it is possible to generate light without consuming electricity. Bio-light from luminescent bacteria that have been fed on methane and organic compost are currently being studied by industrial designers.

Disinfection: The safe purification of water, air, and surfaces using UV-C light requires very little contact time for disinfection, in comparison to other processes, does not affect the smell or taste of treated water, and can be simultaneously combined with a variety of other disinfection and treatment processes.

1. Air purifiers. Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet light (UV-C).

2. Water purifiers. Purification of water where UV-C radiation disinfection destroys bacteria, algae, and viruses can change the chemistry, morphology, and physiology of plants. The UV-Tube Project is part of the Renewable and Appropriate Energy Laboratory (RAEL) at the University of California at Berkeley.

3. Surface disinfection. UV-C disinfection works instantly and continuously to sterilize surface areas, without them being subjected to high temperatures or strong chemicals.

4. Waste treatment. The use of ultraviolet light in sewage treatment is replacing chlorination due to chlorine's toxicity. For example, some large-scale urban UV wastewater treatments are currently underway in cities such as Edmonton, Alberta.

5. Odour removal. Vacuum V-UV propagates only through a vacuum and is readily absorbed by the air. Ozone readily combines with other molecules and is thus used to oxidize molecules and remove odors.

6. Algae to clean wastewater. UV-A promotes an increase in carotenoid production by which plants and algae absorb light energy for use in photosyntesis and protect chlorophyll from photodamage. Algae consume pathogens in the water even as they can be used to produce biofuel. As well, there have been some advances in photobioreactor disinfection using germicidal UV light.

2. Visible Light_Yellow (570 nm / Y)

Mono-frequency yellow lamps. The global cost of lighting is $230 billion per year, but modernizing wasteful technology could save around 60%, reports Ecofys (Energy saving lighting. WWF & AMO). Besides the RGB channels, yellow is used in low-pressure sodium lamps, like those used in some parking lots, which emit a yellow light (wavelength 589 nm).[8]

In Room for One Color, Take Your Time (1997), Olafur Eliasson suggested that these yellow mono-frequency lamps are a very efficient means of lighting, requiring minimal amounts of electricity. They are used for lighting highway tunnels or emergency lights on ferries. The lamps beam light of an almost single frequency; the UV range is very narrow and all other colours but yellow are removed in the mono-frequency lighting from these lamps. The number of yellow receptors in the retinas is large, which is why

the transmission of yellow to our brains is particularly good. In fact, our sight is best with yellow lighting and worst with blue lighting. Similarly, in The Weather Project (2003), Eliasson created a lighting installation for the fourth annual Unilever Series of commissions for the Turbine Hall, taking the transmission of yellow (related to the Sun) as the basis for exploring ideas about atmospheric experience, mediation, and representation. Eliasson claimed that mono-frequency lamps emit light at such a narrow frequency that they transform the visual field around the Sun into a vast duotone landscape.

In his Diurnism project at the Airs de Paris exhibition in Paris (2007), Phillipe Rahm explored about how to create night during the day by attempting to reinvent a new form of night in the continuous artificial day of modernity. He used an bright, orange-yellow light whose wavelengths are higher than the 570 nm perceived by the body through melatonin rhythms as a true night.

Li-Fi (Light Fidelity). There are 1.4 million cellular radio base stations in the world, which consume massive amounts of energy, not for transmission but for cooling down the data stations. The visible light spectrum between 780nm and 375nm is 10,000 times larger than radio waves. Light-emitting diodes are a form of optical wireless communications (OWC) rather than radio frequency waves and are around 100 times faster than some Wi-Fi networks, reaching speeds of 224 Gb per second. Visible light communications (VLC) works by switching LED light bulbs off (0) and on (1) at a very high rate, a form of data transmission using binary code, too quick to be noticed by the human eye, with information recorded in pulses. The tiny bulbs allow streams of light to be beamed in parallel, just as a shower head separates water. Because the light waves cannot penetrate walls, they are more secure from hacking or data leaking, and from electromagnetic interference; as well, there is almost no capacity limitations, as compared to Wi-Fi.

Airlines, submarines, hospitals, and nuclear power stations are looking at this technology as a way to deliver wireless communications, data, and entertainment on board, as current Wi-Fi technology can potentially interfere with communications and security. Submarines could also use their headlamps to communicate with each other, processing data autonomously and referring periodically back to the surface, since Li-Fi can be used under the water without interference with radio interference where Wi-Fi fails. Power plants need fast, inter-connected data systems to monitor things like demand, grid integrity, and core temperature. In the case of hurricanes or earthquakes, if there is light in subway stations and tunnels people can remain online.

3. Infrared Drought Incandescence (hot)

Thermal Infrared scanners. These devices can map sea surface temperatures accurately, chart coastal currents, and quickly identify potentially moist areas by showing temperature variations on various surfaces. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data are used to create detailed maps of land surface temperature, reflectance, elevation and response to change, as well as predicting trends in climate, weather, and natural hazards. ASTER collects data in infrared, red, and green wavelengths of light, which are then combined to make false-colour images: dark blue for water, red for vegetation, yellow for dry land, white for buildings, and grey for roads. The four most common false-colour band combinations are:

1. Vegetation. Near infrared (red), green (blue), red (green). This is a traditional band combination useful in seeing changes in plant health.

2. Floods. Shortwave infrared (red), near infrared (green), and green (blue). This is often used to show floods or newly burned land.

3. Atmosphere. Blue (red), two different shortwave infrared bands (green and

blue). We use this to differentiate between snow, ice, and clouds.

4. Drought. Thermal infrared, usually shown in tones of gray to illustrate temperature.

Microwave radiometers (Water). This device can measure ocean salinity, soil moisture, and other hydrological parameters. An Advance Microwave Scanning Radiometer (AMSR) observes atmospheric and oceanic water-vapour profiles to determine precipitation, water-vapour distribution, cloud water, sea surface temperature, sea ice, and wind speed. As water surfaces can easily be distinguished from other land types in the near infrared domain, this spectral extension of the camera system will be utilized to develop methods and processors for automatic water extraction.

Consequently, monitoring drought conditions and surface moisture status using satellites is of great interest for drought disaster management and for the sustainable development of eco-environments. Water shortage is one of the most important factors limiting crop production worldwide due to the geographically limited availability of irrigation water or the occurrence of drought mainly caused by reduced rainfall. On the other hand, millions of street lamps could be converted to Li-Fi lamps to transfer data, and used in airplanes, submarines, petroleum or chemical plants where other modes of transmission or frequencies could be hazardous. Finally, clean water is a basic necessity of life, above all in floods, and disinfection plants are useful in such cases, but also for improving water quality for people in developing areas where other water treatment methods are not applied consistently because of their cost, inconvenience, complexity, or energy requirements.

NOTES

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7 Franz. H. Shu, The Physics of Astrophysics, Volume 1: Radiation (Berkeley: University of California Press, 1991).

8 WWF, Ecofys, OMA / AMO. The Energy Report. 100% Renewable Energy by 2050. While the Office for Metropolitan Architecture (OMA) remains dedicated to the realization of buildings and master plans, AMO operates in áreas beyond the boundaries of architecture and urbanism such as media, politics, cosiology, technology, energy, fashion, publishing and graphic design.