



STARLIGHT
A COMMON HERITAGE

Work Document

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1.

A dark sky for the development of astrophysics.

The astronomical quality of an observatory is mainly defined by the transparency of its skies and the number of useful observation hours per year. This is closely related to local climatology and geographical characteristics, as well as to the absence of adverse factors affecting observation. The demands of sky quality for astronomical observation means that the number of locations in the world which can be considered excellent is substantially reduced, so that such places must be regarded as a limited resource requiring preservation.

The best locations for astronomical observation in the world, with regard to atmospheric stability and transmission, are of two types: high mountain areas isolated from the temperature of the ocean (for example, Mauna Kea in Hawaii, and La Palma in the Canary Islands), coastal mountains near to cold oceans with stable, subtropical anticyclonic conditions (for example, the coasts of Chile, and the West of Mexico, the USA and Namibia) and zones with large lakes (as in the case of Panguitz Lake in Utah and Big Bear in California). Singular cases of exceptional quality can also be found, such as Monte Maidanak in Uzbekistan, or specific locations in areas as yet unevaluated, like North Africa or Argentina. However, the sky quality in many of these privileged zones can be perturbed by external factors of different kinds.

The best known is light pollution. According to the CIE (International Commission on Illumination), light pollution is a general term to denote the sum of all the adverse effects of artificial light. The most detrimental effects on astronomical observation are derived from the shine or glow of this light in the sky, caused by the reflection and diffusion of artificial light in atmospheric gases and particles. This glow, by reducing night darkness, prevents vision of the weakest sky objects, and contributes to the formation of perturbation lines close to others of astronomical interest. This form of pollution is the result of ineffective shading of external lighting, the use of inadequate luminaries and of excesses in light levels, meaning that part of the artificial light is projected upwards, thereby wasting light intended for ground illumination of streets, squares and amenities, so that it ends up as an irrational deterioration vector for astronomical observation.

Radio astronomy made decisive contributions to several fundamental discoveries in the last century. Despite this fact, radio-electric pollution, that is, pollution produced by radio, television and mobile phone transmitters, among others, constitutes another factor which not only perturbs observatory measuring devices but also invades the radioelectric spectrum in which astrophysical observations are made. This phenomenon, which is undergoing constant increase worldwide as an undesirable by-product of the thriving telecommunications boom, poses a serious threat to observatories.

The third negative factor concerns atmospheric pollution produced by gas, smoke and other small particle emissions which reduce atmospheric transparency and decrease telescope observation capacity. Unfortunately, the sources of atmospheric

pollution are often located at considerable distances from observatory sites themselves.

Contrary to what happens in the field of conservation of natural areas, which can become irreversibly degraded through external threats, top astrophysical observation areas can always be recovered for science and humanity as Dark Sky Reserves. The ability to reverse the negative trends frequently depends on simple political decisions or on citizen responsibility in the conservation of this basic environmental resource.

Objectives

- Consolidation, characterisation and defence of Starlight Reserves for astrophysical research, including not only existing observatory sites, but also potential locations.
- To promote, spread and develop codes of good conduct, municipal ordinances (bylaws) and laws safeguarding Starlight Reserves from the unnecessary effects of light pollution.
- To ensure frequency bands assigned to radio-astronomy remain free from undesirable interference in these zones, including that produced by telecommunication satellites, while defending the concept of internationally protected and restricted zones, with regard to radio-electric pollution.
- To develop the concept of “international tolls on environmental consequences”.
- To promote the creation of protected air spaces around these locations, only crossable in cases of emergency.
- To promote alliances and agreements between government representatives, planners, observatories and astrophysical research centres, the relevant technical development institutions, and industry itself, in the search for viable solutions for the protection of Starlight Reserves.

2.

Benefits beyond the frontiers of astrophysics.

Scientific discoveries connected with astronomy have not only influenced the way we apprehend the universe, but also technology, mathematics, physics, and social development in general, Astronomy is a science which throughout human evolution has created, and continues to contribute, useful tools for human existence. From calendars to navigational instruments, or from modern communications systems based on satellites, to medical applications deriving from the latest techniques in image projection, astronomy has bestowed countless benefits on civilisation. Nowadays, the universe presents itself as an immense laboratory containing vast amounts of knowledge which, once unearthed, could be the source of new applications useful to society, or act as an effective driving force for technological and industrial development. Astronomy is precisely the vector providing access to these new advances and knowledge.

As to the benefits derived specifically from astrophysical observation, the development of materials such as pyrex, with its low coefficient of expansion, used in telescope mirrors and for such everyday applications as vitroceramic cookers could be mentioned, or the new detectors which replace the human eye for capturing the very weak light reaching telescope foci, or infrared radiation technology impelled by the development of modern observatories. In general terms, the selfsame scientific instruments connected to the telescopes provide an excellent stimulus to many specialised industries which, while not necessarily leading to large-scale production of commercial instruments, does have the effect of generating a considerable increase in the technological capacity of the companies involved. To better understand the positive consequences of astrophysical observation, it only needs to be stated that financial turnover expected in coming years, purely in the development of large-scale astrophysical infrastructure with primary mirrors above 3.5m in diameter, presently under discussion and study, and scheduled for the next 15 years, amounts to a total investment, in 2006 figures, of more than 2,250 million euros.

3.

Intelligent lighting, energy efficiency, renewable energies and night sky quality.

The scarcely rational use of electrical energy - which in its day constituted an undeniable element of progress - indiscriminately applied to lighting, is becoming a powerful agent in the transformation and artificialisation of the night.

The current luminotechnical model favours dazzling, in the mistaken belief that an excess of light increases visibility for citizens, when in reality, the result is precisely the opposite. Supporters of the electric night base their thirst for illumination on concepts which have been shown in hundreds of studies to be erroneous and socially useless: concepts such as false security, expressed in the statement that profusely lit cities or roads make for safe cities, or the tendency to confuse light excess with standards of living, prosperity or wealth. Whatever the case, even accepting these arguments, it is utterly senseless to illuminate the sky by using inefficient and technically crude designs and lighting concepts, when the idea is to illuminate the ground, enclosed spaces or house interiors.

The inability to focus light where it is needed is just as unintelligent as being unable to select the right light intensity for each situation, for an over-illuminated atmosphere can be even less safe, and obviously more unpleasant, than a rationally-lit area.

But if the procedures are observed from the point of view of energy consumption, the contradictions of our current luminotechnical model can be perceived even more clearly. Avoiding light-pollution of the sky is one of the few environmental questions with an economically viable solution, especially when the concept of energy efficiency is added to that of eliminating "useless lighting". Most experiments involving the replacement of conventional public lighting with adequately-shaded lamps focussed where illumination is required, and having the additional benefit of low energy consumption, have shown that overall power consumption is reduced between 25 and 30%. Such a reduction not only affects the cost and sustainable management of energy resources, but obviously also has environmentally positive effects connected with reductions in greenhouse-effect gas emissions into the atmosphere which, as we know, constitute another detrimental factor affecting the quality of the night sky. The positive effect is further increased if very low-polluting lamps are employed, such as low pressure sodium vapour models, rather than environmentally harmful ones, such as the mercury vapour or metal halide type.

The enjoyment of a dark sky therefore has a lot to do with our concept of rational energy use, not only in matters of intelligent lighting management, but also in aspects concerned with decisions regarding transport, or renewable energy options, which directly affect atmospheric quality. Thus, it could be stated that an energetically sustainable community is a community capable of enjoying the night sky.

Overall aims

- To promote and spread integrated codes, bylaws and standards regarding energy efficiency and savings, responsible lighting, and sky quality.
- To integrate the dimension of dark sky-responsible lighting into energy planning, and programmes promoting renewable energy, and energy saving and efficiency.
- To foment action connected with intelligent illumination design, in both the architectural field and in urban planning, as well as in engineering, and the development and maintenance of infrastructure.
- To foment the commitment of local authorities in the choice of lighting systems, to ensure that “the public sector sets a good example”.
- To promote labelling in recognition of intelligent products and designs which preserve the quality of the illuminated sky.

4.

The cultural and educational dimension.

In 1992, the Declaration of the IAU/ICSU/UNESCO regarding the "Reduction of Adverse Environmental Impacts" warned that " The sky has always been and still is an inspiration for mankind. However, its contemplation has become increasingly difficult and, even, for the young generations is beginning to be unknown. An essential element of our Civilization and culture is getting lost quickly, and this loss will affect all the Countries in the world ".

A decade later, the preamble to the Declaration of 2009, the International Year of Astronomy, reaffirmed that: " The sky, our common and universal heritage, is an integral part of the environment perceived by humanity. Humankind has always observed the sky either to interpret it or to understand the physical laws that govern the universe. This interest in astronomy has had profound implications for science, philosophy, religion, culture and our general conception of the universe."

The dilemma posed is that, if observation of the night sky has always represented a basic dimension common to all cultures populating the planet since the earliest times, nowadays we run the risk of reducing our everyday astronomical culture to the exclusive domain of a handful of researchers. And all this despite the general interest the subject generates, especially through the use of spectacular images, but which nevertheless fails to conceal the divorce between present-day society and cultural manifestations derived from real observation of the night sky.

Hence, what is first required is to recognise and evaluate the cultural fingerprints left on all cultures, past and present, through the observation of heavenly bodies. From the Mayans to the Sumerians, from the Chinese to the Egyptians, all civilisations, including many prehistoric societies, have sought explanations for divine will in the sky, or believed they could foretell the future from the constellations, or have referred to stellar positions for orientation, for determining the seasonal cycles of crops, for confecting their calendars or for regulating their religious and social ceremonies. The legacy which still remains is simply extraordinary: monuments, calendars, cults and myths, symbolic representations, concepts and objects related to astronomy, temples, sanctuaries, urban complexes, cosmological traditions, artistic manifestations and festivities. A heritage which, taken as a whole, possibly represents the most impressive evidence of cultural diversity, both material and immaterial, common to all peoples on the planet.

Secondly, efforts must be made to incorporate past and present astronomical culture into educational and information systems. Surprisingly little space is generally given to "astronomical culture" in education, bearing in mind its significance, and real repercussion in the present scenario of a Society of Information and Knowledge.

Objectives

- Identify and promote initiatives to enhance the value of material and intangible cultural heritage associated with astronomy, hence reinforcing our knowledge of the skies and of the associated cultural expression diversity.
- To reinforce the network of museums and observation centres open to visitors, in defence of the quality of the night sky.
- To promote the various forms of “cultural astronomy”, such as ethnoastronomy and archaeoastronomy.
- To promote the night sky dimension in programmes of environmental education.

5.

The night sky, a source of inspiration.

“We are children of clay, but also of the starry sky” (náhuatl saying)

The sky, universal heritage common to all, is an integral part of the environment perceived by humanity. Mankind has always observed it, either to interpret it, or to understand the physical laws governing the universe, but, in particular, interest in the sight of heavenly bodies has powerfully influenced artistic manifestations. John Constable, the English painter, said that the sky “was the chief organ of sentiment”.

A large part of our present-day generation is the first in history to grow up with no experience of the beauty of a starry sky shining overhead. Nevertheless, the grandeur of the universe at night, and its powerful aesthetic appeal, has impregnated the development of art, music, poetry and dance throughout the centuries. The night sky should rightly continue to be one of the principal windows to the world for artistic creation.

Objectives

- To identify and promote artistic manifestations related to the vision of the night sky
- To promote art meetings based on the defence of the quality of the night sky as a creative resource and artistic right.
- To evaluate present-day indigenous artistic manifestations related to starlight.

Referenece actions

- The Biken Foundation (Japan), a creative international project for young artists inspired by the sky.
- “Festival du Vent”, Corsica.
- The “Imagine the Night!” award (IDA).

Suggested partners

- UNESCO
- International Dark-Sky Association
- Biken Foundation

6.

Environmental aspects

Loss of biological diversity and impact on ecosystems.

Life in 24 hours.

Knowledge of natural systems has advanced considerably through analysis of the critical role played by natural darkness in the interactions and behaviour of species. Nevertheless, with few exceptions, the ecological consequences of artificial night, and the effects of light pollution, have not been investigated by scientists with the attention this important phenomenon deserves. Over the last century, the degree and intensity of artificial light at night has increased to such an extent that no-one can deny its present-day negative effects on habitats and natural species. A distinction must be made between the consequences of "astronomical light pollution", which affects vision of the night sky, and "ecological light pollution", referring to alteration of natural light regimes in terrestrial and aquatic ecosystems.

As novel forms of pollution, they have generally been little studied and inadequately evaluated so far. However, information is beginning to appear indicating their clear effects on certain migratory species guided by star-light, or concerning such obvious phenomena as the mass mortality through dehydration suffered by certain sea turtles disorientated by light on their home beaches. Atmospheric damage through the use of inadequate lamps and the effects on flora and fauna must not be forgotten either.

But the lengthening of artificial night in the natural environment has other, less known or obvious consequences. Among them, the noteworthy alteration of ascent and descent cycles of marine plankton, affecting the feeding of marine species, or the undesirable effects on population balance in certain species, some of which are blind to certain light wavelengths while others are not, so that predators are able to thrive as their prey is driven to extinction. Flora can also be affected by phenomena such as population descents of pollinating insects, which could also indirectly affect the productivity of certain crops. Additionally, the prolonging of photosynthesis induced by artificial light leads to abnormal growth and disturbance of flowering and vegetative rest periods.

Objectives

- To promote the inclusion of unspoilt night skies as a basic objective in biodiversity conservation strategies, and in measures designed to protect ecosystems and habitats of natural interest
- To increase knowledge and understanding of the scope of the ecological consequences of artificial light at night, a crucial conservation challenge opening new windows and opportunities for basic and applied research
- To propitiate research into the ecological dimensions of light pollution, fomenting collaboration among the natural, physical and engineering sciences.
- To propitiate the development of networks of protected areas which include the maintenance of unperturbed night skies in their management and conservation strategies. The worldwide network of Unesco Biosphere Reserves constitutes a

group of suitable laboratories for responding to the new concepts of reserves of the night sky.

7.

The right to starlight

When the sun dips below the horizon, a large number of human settlements on the planet become artificially illuminated, creating a cone of light capable of eclipsing the subtle glimmer of stars. Every day, two thirds of the Earth's inhabitants never see the sky as it really is, a peculiar phenomenon which is aggravated in the European Union and the United States, where the firmament is never dark for 99% of the population. The most striking evidence of the destruction of our dark, starlit skies is provided by the disappearance of the Milky Way, which can only be admired in all its splendour at considerable distances from most urban areas.

To fight against light pollution means to pursue a common goal, by attempting to preserve for future generations the right to a purer environment. We all have the right to observe the stars, and we all have the right to include the starry, nocturnal skylines above our villages and towns among those memories processed by our own retinas. From this perspective, the right to a clear night sky has arisen in our times as a new social demand affecting standards of living, personal development, and the opportunities for enjoying a tremendous variety of landscapes which are presently hidden from view.

The right to a clear sky should be compared to the right to live on an unspoiled planet, or the right to sufficient water and energy. Similarly, pollution and the loss of dark skies should be placed on the same level of importance as demands for air quality, water and the conservation of natural resources. Nowadays, talking about sustainable development also means talking about guaranteeing a clean night sky for ourselves, and for future generations.

In recent years, great efforts have been made to recognise, articulate and exercise this right. It is nonetheless true that most initiatives have come into being as an extension of the requirements for astronomical observation. For that reason, most of the laws and bylaws developed outside astrophysical observation areas so far have almost exclusively been aimed at palliating the harmful effects of artificial light. They all share the common aim of achieving a less light-polluted sky, although the focus varies between those laws which pursue respect towards the night environment in a general way, those which try to avoid energy waste, and those which attempt to protect a specific natural area.

In all cases, the results obtained lead to the enjoyment of clean, starry skies. It is therefore high time to take a further step forward, by defending the right to star light in all dimensions, as an environmental right which includes human health and personal enjoyment of nocturnal landscapes. In fact, it is not such a complicated commitment as is the recovery of an extinct species, or the fight against drought or erosion, or the loss of natural areas as a consequence of over-development: the night sky is 100% recoverable in all its dimensions.

Objectives

- To regard light pollution as a troublesome, pernicious phenomenon in ambits regulating citizens' welfare, with at least the same importance as noise production, vibrations, and contaminating emissions.
- To promote the right to personal and general enjoyment of clean night skies.
- To consider the diversity of clean sky nocturnal landscapes as a resource to be protected.
- To preserve the right to privacy by protecting citizens from intrusive light sources.
- To promote the idea of Dark Sky Reserves in all ambits, both urban and rural, and to consider the possibility of introducing into territorial planning "specially protected dark sky areas" in places with special scenic value which are still unpolluted.
- To generate an awareness of night sky protection on the part of local authorities, as a basic citizen's right.

8. **Starlight and tourism.**

Tourism, one of the most important and innovative activities on our planet, could act as the vector of a new alliance for promoting the quality of the night sky. The sight of a clear sky can rightly constitute an asset for the development of specific products geared towards scientific or “knowledge tourism”, but it is also a frequently forgotten attraction influencing the quality of a tourist destination as an additional scenic element. At times, the starry sky forms part of the very essence of the tourism product, such as in the case of observations of the Northern Lights, the multitude of sailing holidays featuring navigation by the stars, some pilgrimage routes, or the innovative visions offered by desert tourism.

The firmament, as a scenario for tourism in modern times, has been present as a basic reference point in historical destinations such as Santorini or Taormina. “Venezia, salvare la notte”, the slogan for one of the most important meetings in defence of the quality of the night sky, warned of the danger of forgetting the beauty and appeal of the night for an activity mobilising more than six hundred million people a year. This vital resource has almost fallen into oblivion due to tourism’s rapid development, standardising and massification. The present challenge is to reintroduce this resource as a basic part of the offer for those destinations which still have a chance to recover the clarity of their night sky.

The cultural heritage associated with astronomy also acts as motivation for many travellers nowadays. At present, there are many consolidated locations and destinations in which heritage connected with astronomy, including their archaeoastronomical heritage, constitutes the tourist attraction par excellence.

Observatories and their surroundings are also candidate areas for the development of innovative and respectful tourism activities, where, with intelligence, visits can be made compatible with the careful protection of the extraordinary natural conditions at such locations, and their quality for astronomical observation.

Objectives

- To value the night sky as a tourist attraction and asset at destinations having adequate potential.
- To promote the exceptional nocturnal skylines as basic resources in a new generation of tourist products.
- To value and recover the material and immaterial cultural heritage connected with astronomy and star observation as a tourism resource.
- To promote formulae for responsible and knowledge tourism centred on astrophysical observatories, bearing in mind that researchers should not remain isolated in their ivory towers, nor should observatories be considered inaccessible strongholds closed to the public’s curiosity, the driving force behind travel throughout history

- To incorporate the clean sky criterion in the strategies of sustainable tourism destinations.
- To incorporate responsible lighting criteria in the certification and eco-labels of responsible tourism.