

# The Biopolitics of Melanopic Illuminance

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## THE NEW TECHNOSCIENCE OF LIGHT

Recent neurophysiological research has revealed the non-visual biological responses of different forms of photosensory input located in the eye's "melanopsin-containing intrinsically photosensitive retinal ganglion cells," which regulate the body's hormonal and behavioral responses to light.<sup>1</sup> These responses affect sleeping patterns, blood pressure, and stress levels, and this discovery has led to proposals to adopt a new photometric measure of light based in non-image forming biological responses rather than light intensity perceived by the eye, measured in "lux."<sup>2</sup> We are now entering the melanopsin age.

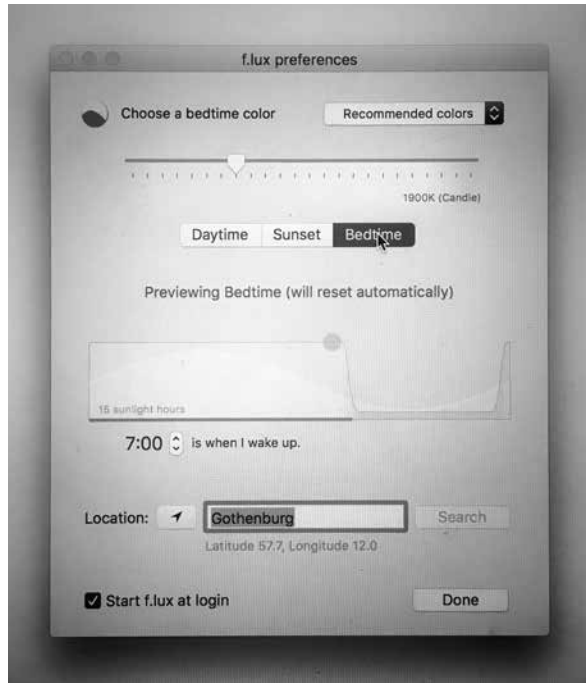
Since melanopsin was discovered in mice and frogs in the early 2000s and later found to be present also in humans,<sup>3</sup> this research has enabled a better understanding of the health effects of exposing humans to natural light, including its role in synching the internal biological clock of hormone responses with the solar day. This understanding is now being applied by the lighting industry, where a revolution is taking place, driven by this new science and augmented by EU regulations phasing out traditional light bulbs to save energy.

Regulating light can, for example, prevent "chronodisruption" for shift workers

forced to work at night and sleep in daylight, increase alertness in classrooms, and reduce stress in the evenings. There is thus a relation between quality of light and quality of life, which means that there is money to be made and saved, not only from decreased energy consumption, but increased productivity and lower healthcare costs. Indeed, the EU has invested heavily in the new sciences and technologies of light, hoping for a revitalization of the old European lighting industry, producing high-end, sustainable, and high-quality light in Europe, as opposed to the cheap-light manufacturing industry in Asia. Up until recently, the drive has been towards increased light intensity per monetary input, disregarding the quality of the light itself.

The new lighting technology is based on scientific experimental results in laboratory settings—labs that have now moved out in "the real world" and involve "real people." But the scientific advancements themselves are also dependent on advancements in lighting technologies to be able to set up experiments using tightly controlled and variable light sources in order to measure their impact on various biological indicators. This forms the kind of "private-public partnerships" between academia and industry—between science, technology, and markets—that the European Union has invested so heavily in.

These efforts showcase the European approach to user-centred design, where



industry and academia work closely with end-users in the health, education, and ergonomic sectors. For example, the EU-funded project “Lighting for People”<sup>4</sup> is composed mainly of German and Dutch engineering and medical science firms, with users from the always light-sensitive Nordic countries (interestingly enough, also countries with an average high productivity and low working hours). There is even talk of a “human-centered lighting” movement in academia, industry, and policy circles. This emphasis on the new properties of light has enabled the lighting industry to promote value enhancement, making up for the higher production costs in European countries by promising increased returns in terms of wellbeing and productivity. The IT infrastructures needed to control the new lights could also enable the European Information and Communications Technology (ICT) industry to get a much-needed head start over the Americans in the “Internet of Things” by integrating the efforts of different industries and academia.

This is the European dream of science and technology: the creation of societies

that are both good for the wellbeing of the population and productive for capital. Science and technology are seen as able to mitigate the negative impacts of the internal contradictions of capitalism by providing the optimal conditions for both work and reproduction.

#### LIGHT IN 24/7 CAPITALISM

If the new techno-science of light is an example of an attempt at solving the internal contradictions of capital around the needs of production and reproduction, other developments threaten to destabilize this peace. This where Jonathan Crary situates the contemporary Western worker in 24/7: Late Capitalism and the Ends of Sleep, a book about the recent, scandalous alterations to our patterns of sleep, rest, and recovery.

DARPA, the U.S. military research agency, started sleep research with the intention of designing a super soldier able “to go for a minimum of seven days without sleep, and in the longer term perhaps at least double that time frame, while preserving high levels

of mental and physical performance.”<sup>5</sup> Crary aptly starts his book describing the origin of this military research, which is found in the migration patterns of the white-crowned sparrow across North America, where this bird stays awake for a week until it reaches its destination. The aim behind understanding this behaviour is to produce both a “sleepless soldier” and “discover ways to enable people to go without sleep and to function productively and efficiently”<sup>6</sup>—a sleepless worker. Thus, military experimentation with sleep has been applied to active US combatants who are sent to the battlefield under states of sleep deprivation, but also to prisoners, such as those in Guantánamo, where torture techniques are combined with controlled lighting environments to gain “complete control over sensory and perceptual experience.”<sup>7</sup> Crary also describes how Guantánamo’s “high-interest” prisoners are kept in cells that are constantly lit, but they need to wear eye masks when escorted outside their cells to prevent them from distinguishing between day and night, but moreover to produce a “world that radically excludes the possibility of care, protection, or solace.”<sup>8</sup> The elimination of the difference between night and day, between light and darkness, makes possible what Crary defines as a “time of indifference,”<sup>9</sup> where managing light becomes a power-knowledge capable of inflicting psychological damage.

The intensification of work engendered by the rise of neoliberal policies in the 1980s created an ideal new worker able to perform all the demands of unregulated markets in a successful and efficient way. DARPA’s sleepless soldier turns out to be nothing more than “the forerunner of the sleepless worker or consumer.”<sup>10</sup> Sleeping is for losers, we are told.<sup>11</sup> Crary analyzes how sleep is seen as an obstacle to compliance with the cycles of hyper-capital, articulating it as a space where non-activity takes place and therefore prevents the complete realization of the nightmare of “working without pause, without limits.”<sup>12</sup> He also successfully historicizes the aesthetics of

light using painting and cinema, but his everyday examples communicate better the historic role of light as a driver of economic activity and its impact in urban settings. For example, he offers a simple description of how bringing electricity to streets not only tamed popular anxieties associated with the dangers of night in the nineteenth century, but also expanded the time that shops could be open. Today, extended shopping hours have greatly intensified, and the omnipresent 7/11’s signify the image of the sleepless soldier satisfying the need for permanent consumption in a 24/7 world: “There is no moment, place, or situation that now exists in which one cannot shop, consume, or exploit networked resources.”<sup>13</sup>

However, for Crary, “sleep is a ubiquitous but unseen reminder of a pre-modernity that has never been fully exceeded, of the agricultural universe which began to vanish 400 years ago.”<sup>14</sup> That agricultural society followed the movements of the celestial bodies from day to night, and from season to season. Today, the pause, rest, and recuperation that sleep provides are simply being eroded and supplanted by artificially induced Pomodoro<sup>15</sup> breaks, sleeping-aid prescriptions such as Ambien, natural supplements like Valerian root, and media technologies such as f.lux, an application that calibrates the colour of LCD screens depending the time of the day in a given time zone: “warm at night and like sunlight during the day.”<sup>16</sup>

For Crary, managing time in 24/7 capitalism “is not simply a continuous or sequential capture of attention, but also a dense layering of time.”<sup>17</sup> This led to Crary leveling most of his critique at deep media technologies (such as the television, and now computers and mobile phones), identifying them as the main culprits behind 24/7 networked insomnia in which a multiplicity of temporal layers from across the globe come together in the same digital streams. He also focuses on the erosion of sleep as a product of financialization and hyper-active semiotic activity, for which a “sleep mode” is needed

to actively prevent us from participating in economic networks that allow constant communication through the glow of cyber-capital, “transposed into eternal light via the shimmering and flickering” of personal screens.<sup>18</sup> Sleep mode, however, is not a sufficiently powerful interruption anymore; in the 24/7 horizon we even produce value in our sleep through our digital identities—ever-present, on-line and ready to be linked and retweeted at any time. In fact, users of apps that optimize sleep generate data that are monetized.

#### F.LUX AND THE NEW TECHNOSCIENCE OF LIGHT

Sunlight is our drug, but domestic lighting is like a vitamin. It can provide us with a kind of nutritional support.  
– Professor Herbert Plischke of Munich University of Applied Sciences and the EU-funded project “Lighting for People,” 2014

With personal electronic devices, the concerns of the biological impact of light move beyond simply having adequate light in the workplace or classroom to compensate for a lack of natural light, to regulating the entire biological rhythm of activity and sleep in both the public and private spheres. Indeed, workers who stay up late, losing sleep in front of poorly lit computer and mobile-phone screens (the latter having even brighter screens to be visible outside in daylight), suffer from decreased productivity during the working day.

f.lux is a free OS-X app based on melanopic research aiming to regulate the biological rhythms of computer users.<sup>19</sup> By letting users set their location, f.lux will adapt to the daylight cycle and adjust the frequency of the screen light to the correct melanopic illuminance to prevent disruption of the biological sleep response: low, red luminance at night for sleeping; high, blue luminance in the morning for waking up. The user has options for sleeping in on weekends, allowing an extra hour of sleep for teenagers,

and disabling f.lux until sunrise for pulling an all-nighter. f.lux is thus still attached to a nine-to-five working day, perhaps reflecting the personal experiences of former Google employees Lorna and Michael Herf, who created the program. A freelancer chasing a writing deadline might have come to up with a different interface.

The problem tackled by f.lux is remarkably expressed by Jean-Luc Nancy in The Fall of Sleep:<sup>20</sup>

How to sleep in a world without a lullaby, without a lulling refrain, without a capacity for forgetting, without unconsciousness itself, since Eros and Thanatos patrol everywhere shamelessly, sardonic watchmen armed with whips and cudgels? How to sleep in a world hypnotized by the vision of its own absence of vision of the world, as well as by the inanity of all visions that have dissolved but that always used to promise awakenings, triumphant mornings following splendid evenings in the blaze of which night has been forever discredited?

f.lux is an answer to the question of how to sleep in a world where everything is always updated, yet everything remains the same, without any hope that tomorrow will be different from today. It is also an answer that bypasses the conscious part of the brain and thus an answer without a philosophy, and a sleep without any dreams.

With the borders between the public and private spheres being erased in the quest for the total management of people’s productivity and wellbeing, melanopic light regulation technologies like f.lux could become an integral part of health programs, and even mandatory conditions for health-insurance policies (with the extra benefit of being easily and remotely monitored online). They also are likely to become an integral part of the management of urban space.

#### SMART LIGHT, SMART CITY

LED-lighting—whose benefits up until now have mostly been presented in terms of potential energy savings—coupled with information technology and sensor networks can enable lighting conditions in urban areas to be controlled remotely, in response to certain local environmental conditions or specific commands. This enables the light grid to become an integral part of the push toward “smart cities” that can be adapted to specific needs in real-time; light-as-service.<sup>21</sup> For example, a certain area can be lit or dimmed depending on the environmental or social context, light can be micro-managed by creating luminous corridors for people to follow, and it can be used to enhance alertness or relaxation of visitors and inhabitants. The introduction of LEDs in combination with ICT also challenges the policy structures of urban governance. Previously, light had been seen as a simple matter of installation and maintenance, but now it must be integrated with all other infrastructural systems and variables to create the unified “smart governance” of the city (in the form of the infamous Public-Private Partnerships).<sup>22</sup>

These new lighting technologies open up the possibility of different urban melanopic “illuminance zones,” with precise resolution in time and space, creating a fluid and dynamic transition between indoor and outdoor spaces. Residential areas could be lit with more red light to keep the noise down, while commercial areas can receive more blue light to increase activity. Areas outside nightclubs can have blue light around opening hours, but red light when they close to reduce alcohol-induced aggressiveness.

The new techno-science of light is not only aiming to become an integral part of architecture, but is also fundamentally anti-architectural in its generic applicability and ability to create optimal light conditions in any kind of environment. With these technologies, for example, there is no need to construct buildings with a large inflow of natural light. In the field of architecture, however, there is an

increasing focus on daylight and its effects on wellbeing, including standards for measuring daylight exposure in buildings (such as the new European Daylight Standard), and new software to aid in the design and simulation of daylight exposure, as well as designing urban spaces for social behaviours that get people moving outside more and make cities more walkable.

#### UNBOUNDING SUN AND TIME

That “light is a drug” also means that artificial light is a biotechnology, where before it was only an information technology, as the sun was for a long time used for navigation and localizing moments in space and in time. Similarly, urban lights have material properties beyond their role as information carriers (such as traffic signals and advertising billboards) and information illuminators (lighting up a building or an environment), which regulate and disrupt biological rhythms.<sup>23</sup>

We are now at a time where time-keeping is becoming disassociated from the solar day and instead run by a network of atomic clocks that only occasionally sync with the sun—out of courtesy for human cultural patterns—as leap seconds are used to account for the variability of the Earth’s rotation. However, a controversial proposal is in the works to remove leap seconds because of the many computing problems they create, meaning that we would no longer keep daylight and time-keeping in sync. Lighting technologies thus open up to a dynamic and optimized multiplicity of light conditions where the demands of work and biological responses do not need to rely on our relation to the celestial bodies of the sun, the moon and the earth—making it easier to sleep during the day and work during the night.

The planning of light exposure in the proper frequencies and amounts is handled by a variety of algorithms, from artificial lighting systems and smart buildings that regulate the influx of natural daylight, to navigational software that suggests routes with optimal light exposure. The resolution by which the





Rick Silva, "Rendering," 2015. Image Courtesy of the artist.

sun and the Earth's rotation regulate biological rhythms is too low, as they follow a steady cycle and vary only over large geographical areas. Or worse, they regulate rhythms in a disorganized way, with weather, trees, mountains, billboards, and light pollution disrupting sleep cycles. Optimizing productivity to capitalism's demands requires more than this—in the melanopic age, biological clock

rhythms have become a techno-scientific matter.

IF YOU DON'T LET US DREAM, WE WON'T  
LET YOU SLEEP

From the Middle Ages there is record of the struggles and injustices related to labour, where the night was the battlefield. In Caliban

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and the Witch, Silvia Federici provides an account of the effects of the decriminalization of rape in the fifteenth century, where French authorities began tolerating "the brawls, the presence of youth roaming the streets at night in search of adventure and disturbing the public quiet" in exchange for minimizing the prospect of insurrection.<sup>24</sup> In the late 1700s the creation of medical schools alongside the rise of the bourgeoisie, fueled the emergence of a "corpse-economy,"<sup>25</sup> where the Anatomists enlisted Resurrectionists to steal proletarian bodies from their graves at night, or just simply murder people to meet their cadaver demands. The role of light in this struggle was clear:

Indeed 1818, the year the first edition of Frankenstein appeared, also saw the marketing of a metal coffin, explicitly meant to thwart body-snatchers. The poor, of course, could not afford these luxuries. Their only recourse was collective self-organisation. Not only did they organise to light and protect their graveyards, they also rose up against the resurrectionists, frequently inflicting physical injury on them.<sup>26</sup>

Technologies providing light and quality of life, including a good night's sleep, meant darkness for some and exploitation for others. This was true in the 1800s, and no different today. In the "The Working Day," Marx describes the rapid development of "Lucifer" matches across England at the same time that a condition affecting jaw muscles spread among matchmakers, a job where back then "half the workers are children under thirteen, and young persons under eighteen." The unhealthiness and unpleasant odors were so bad in this job that only the most miserable part of the labouring class, starving widows and so forth, gave their "ragged, half-starved, untaught children" over to it.<sup>27</sup>

Therefore, it is no coincidence that one of the first demands of the workers' movement in the nineteenth century was an eight-hour workday. The night was needed to recover from such drudgery (and for planning

communist plots). One might even say that the regulation of light is associated with the regulation of labour; paraphrasing Cubitt, Palmer, and Tkacz, editors of Digital Light, the history of light might be the history of human affairs.<sup>28</sup> And since the relation between night and labour is nothing new, it needs to be updated to account for the current struggles over hyper-capitalist production, as Cray concludes by proposing sleep as a collective condition of renewal required for the production of a post-capitalist world, where freedom might begin with "dreams of sleep."<sup>29</sup> He wants to politicize the act of sleeping at a time when users are just peasants of information, meeting and communicating through screens and not around bonfires.

Unfortunately, capitalists themselves are also pursuing these dreams of sleep. Take, for instance, The Sleep Revolution, the new book by the media mogul and wellness evangelist Arianna Huffington, who much like Cray addresses the sleep crisis, identifying our relation with networked and social media technologies as the main culprit behind our sleeplessness and exhaustion. But she distinctly understands sleeping as an asset: "properly appraised, our sleeping time is as valuable a commodity as the time we are awake."<sup>30</sup> Indeed, the luxury of choosing sleep over work has always been matter of class. Huffington does advocate for choosing sleep over (just) busywork in her promotional manifesto<sup>31</sup> and even acknowledges in her book how the Industrial Revolution redefined the relation between sleep and work, where "owners and managers treated human labour as a commodity in the production cycle—one that they tried to obtain as cheaply and use as efficiently as possible."<sup>32</sup> However, a closer look reveals that her own employees need to take second jobs, and "work continuously, whether you're at the office or not. [...] That little green light that says you're available on Gchat is what matters."<sup>33</sup>

Today sleep is a research field that is producing everything from wellness evangelism to conferences, papers, technological innovations, and products

such as intelligent sleeping masks<sup>34</sup> and spa treatments in sleep cabins—charged by the minute—with “computer-controlled ambient lighting to lull you into your power nap.”<sup>35</sup> There is now investment being poured into understanding and nurturing sleep, because as Nordic social democracy discovered in twentieth century, the wellbeing of workers is the wellbeing of capital. As Huffington and the market for state-of-the-art products for aid sleep show us, Crary’s Marxist position is valid, pointing out how everything, including bodies and their sleep, is and will be commodified. However, it is also important to consider the position of techno-scientific feminists like Donna Haraway and Judy Wajcman, who critically address this condition but still try to construct meanings that enable us to mutually shape our technologies and realize that the “very same devices that can make us feel horrid, also enable us to take more control of time.”<sup>36</sup> But could we ever make a bonfire out of f.lux?

The relevance of Crary’s approach in 24/7 is that it provides an urgent understanding of the new biopolitics of melanopic illuminance, one that demands we shift the disproportionate power attributed to information technologies towards sleep itself, as a vital non-activity able to at least equalize and transform our relation with these technologies to create “a persistent counterpoint to the rationalist and instrumental modernisation of light.”<sup>37</sup> Cubitt, Palmer, and Tkacz continue: “There is no absolute rift between the material practice of managing light and its emblematic function as the symbol of divinity, reason, or knowledge. There is, however, a dialectic between symbolic and material functions of light.”<sup>38</sup> If technologies are just frozen social relations and the crystallization of our priorities as a society,<sup>39</sup> then maybe we are just in time to melt them in our dreams and allow movements and shifts toward the self-organization of our imaginations—thus creating the fire of divine light, the conscious and communal overuse of stroboscopic light at the rave, and even the unknown of absolute darkness.

NOTES

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