

Sanatorium Zonnestraal and a Case for a Critical Approach to Light Exposure

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Jan Duiker’s Sanatorium Zonnestraal, built in 1926 to 1931 near Hilversum in the Netherlands, is an exemplar of modern architecture designed as a hygienic machine. The building has continued to be recognized for its significance not only for its modern construction methods and materials but also as an emblem of healing architecture in the times of tuberculosis. Fresh air and light were delivered to the patient through the architecture. This paper examines Zonnestraal through the notion of light exposure. Furthermore, a critical study of this building suggests a nuanced mode of thinking about light exposure in today’s buildings and cities—one that responds to specific contexts and time by synthesizing daylight with electric light, and by embracing a range of exposure from filtered to bright, from direct to indirect light.

INTRODUCTION

Jan Duiker’s Sanatorium Zonnestraal, built in 1926 to 1931 near Hilversum in the Netherlands, is an exemplar of modern architecture designed as a hygienic machine. The photograph of its long horizontal lines of flat roofs and balconies, with tree canopies beyond seen through the long horizontal windows, is a striking icon of sanatoria from the early 1900’s. Dutch Functionalism, to which Zonnestraal belonged, was imbued with ideal of light, air, and hygiene. Its name, the Dutch word for *sunbeam*, honors the healing power of the sun. The building has continued to be recognized for its significance not only for its modern construction methods and materials but also as an emblem of healing architecture in the times of tuberculosis. Fresh air and light were delivered to the patient through the architecture. Zonnestraal was designed as a medical instrument of exposure to sunlight and air. This paper examines Zonnestraal specifically through the notion of light exposure.

Despite its architectural significance on multiple fronts, the building was designed at a time in which scientific proofs of healing through architecture were relatively unchallenged. As Margaret Campbell



Fig. 1 Zonnestraal following restoration. Photo: Michel Kievits/Sybolt Voeten.

claims in her paper “What Tuberculosis did for Modernism,” the breakthrough in triple drug therapy in the 1950’s “ruptured the direct association between architectural design, treatment, and physical recovery.”¹ While one could argue that the discovery of drug therapy rendered Zonnestraal obsolete, there are still lessons to be learned from this exemplary building. A careful analysis of Duiker’s project reminds us that critical lenses are necessary in viewing today’s evidence-based design and scientifically proven solutions. The study of Zonnestraal through the notion of light exposure also suggests a more complex mode of thinking—one that responds to specific contexts and time by synthesizing daylight with electric light, and by embracing a range of exposure from filtered to bright, from direct to indirect light.

ZONNESTRAAL

In the 1910’s, the diamond polishing industry in Amsterdam employed over 10,000 people, many of whom contracted tuberculosis from breathing diamond dust. The sanatorium was built as an aftercare colony for diamond factory workers recovering from tuberculosis. The Dutch Diamond Workers’ Union raised funds by selling copper waste from copper rods that held diamonds, and diamond powder collected from the workers’ overalls.²

The sanatorium movement flourished in the Swiss alps, based on the Germany Romantic belief in the healing power of mountains. Davos became a place of healing for the wealthy, and patients came from all over the world. Thomas Mann’s 1924 novel *Magic Mountains* is a story of a man’s treatment for tuberculosis at a Swiss sanatorium, based on Mann’s observations during his wife’s stay at the Waldsanatorium in Davos. Paimio by Alvar Aalto and Hilversum sanatoria, built on flat lands, are two well-known exceptions.³

Built on a 286-acre woodland estate forty minutes from Amsterdam, Zonnestraal consisted of central service buildings from which two residential wings spread into the woods. Each wing had two linear two-story pavilion set 45-degree angle to each other so that the view and light from each room could be maximized. The name Zonnestraal, or ‘sunbeam,’ is discernable in the sparkling sunlight caught in the ripples of the drawn glass of the long ribbon windows.⁴ The radial plan is also suggestive of rays of sun or a sparkling diamond.

Zonnestraal is an embodiment of *Nieuwe Bouwen* (‘New Building’), a Dutch thread of the international Functionalist movement of the early 1900’s.⁵ The 1928 La Sarraz CIAM declaration included a call for new materials, construction techniques, and the ideal of light, sun, air, and hygiene.⁶ In the patient pavilions of Zonnestraal, reinforced concrete slabs and columns enabled long span and unobstructed

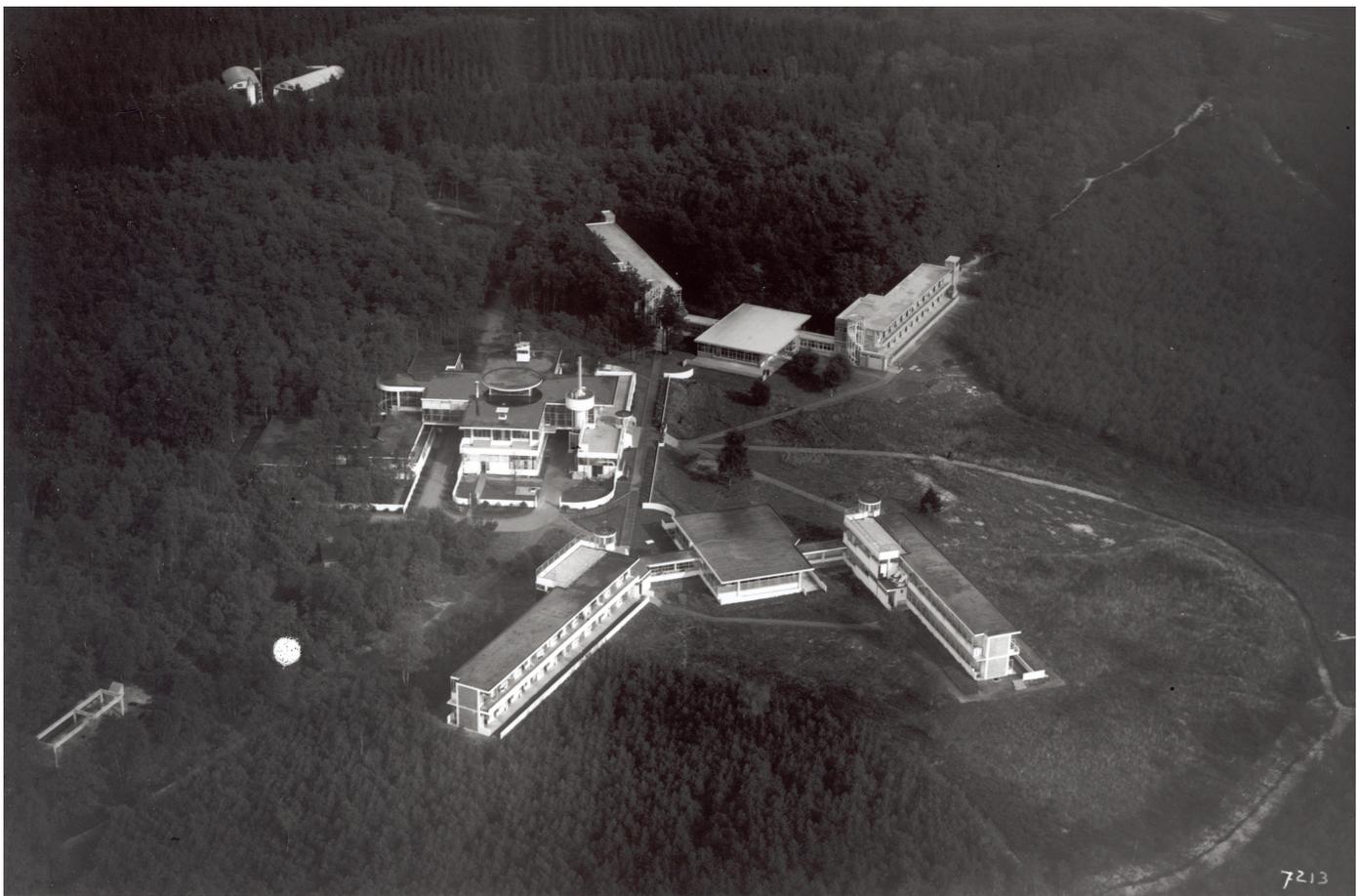


Fig. 2 Zonnestraal’s aerial view. Fingers reach out to the landscape for exposure to light. Photo: KLM Aerocarto.



Fig. 3 Patients taking in light and fresh air. Courtesy of Internationaal Instituut voor Sociale Geschiedenis (IISG), Amsterdam.

views, and steel frames facilitated ribbon windows which allowed daylight to stream into the buildings. The plans of patient rooms were configured as fingers that reach out to the landscape for exposure to light. The flat roof became balconies with beds for the patients to rest in open daylight while taking in fresh air. Beatriz Colomina writes,

Nineteenth-century architecture was demonized as unhealthy, and sun, light, ventilation, exercise, roof terraces, hygiene, and whiteness were offered as means to prevent, if not cure, tuberculosis. Modern architecture's publicity campaign was organized around contemporary beliefs about tuberculosis and fears of the disease.⁷

Nieuwe Bouwen promoted freeing of structure from unnecessary weight, thereby liberating the structure both materially and spiritually. Duiker designed with the intent that the building would be temporary, that it becomes obsolete and demolished when a cure is found.⁸ To that end, the building was built with minimum amount of materials, using experimental, thin reinforced concrete construction.⁹ Working with structural engineer Jan Wiebenga, he carefully shaved off excess materials until no more materials could be removed.

There is a fragile beauty to this early modern architecture, as Peter Smithson described in 1962: "His buildings are just buildings, and when one says that their poetry is slightly mad, it is I think because they have a purity and faith that we find almost too hard to bear, it shines out of the smallest detail, the windows for example at Sonnestraal, and the small white walls round the trees."¹⁰ Duiker accurately predicted the active lifespan of Zonnestraal at 30 years. Following an abandonment in the 1980s, Zonnestraal was restored between 2001 and 2003 by Hubert-Jan Henket and Wessel de Jonge.

EXPOSURE: LIGHT THERAPY AND X-RAYS

In 1929, Sigfried Giedion published *Befreites Wohnen* ('Liberated Living'). The cover, which he designed himself, has the words 'Licht,

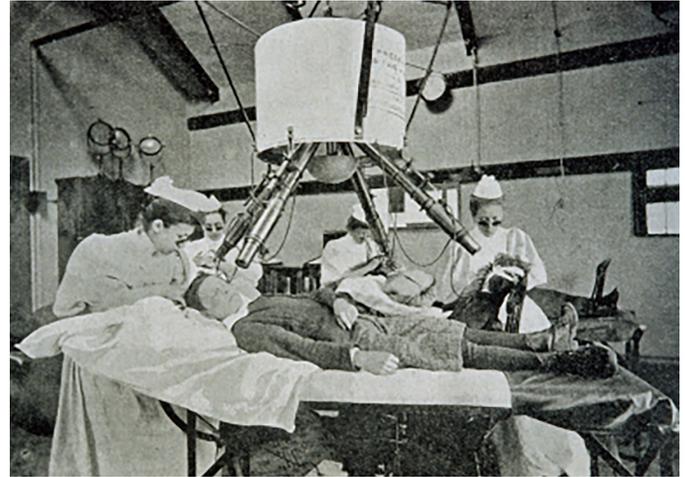


Fig. 4 Finsen light treatment for Lupus, 1900. Courtesy of Wellcome Library, London.

Luft und Oeffnung (light, air and openness) placed repeatedly across a photograph shot on the balcony of a building in Zurich. Photographed from inside a modern interior looking out over the city, the image shows a man leaning on the balcony balustrade as a woman relaxes on a reclining chair, taking in sunlight and fresh air. The book prominently features hospitals and sanatoria as examples of 'Liberated Living'.¹¹

Long before modern architecture became associated with healing through light and air exposure, the field of medicine had explored healing through light beginning with Hippocrates. From the late 1800's, heliotherapy was a common treatment for tuberculosis. Sunlight was known to kill bacteria that caused illness; and sick children, especially those who grew up in urban slum housing, were encouraged to play outside as much as possible.

With industrialization came artificial forms of light. In 1895, physicist Niels Finsen began treating lupus patients with ultraviolet light and enabled exposure to artificial light at any time of the day even in rooms with no access to sunlight.¹² The Finsen lamp consists of a powerful arc light surrounded by a metal screen, from which four cylinders project downward. Each cylinder has four lenses which allow the nurses to aim the light precisely on the scabs of a lupus patient for one hour.¹³ Finsen's work was instrumental in encouraging development of radiation therapy.¹⁴

Another instrument of exposure contributed to treatment of tuberculosis at around the same time: the x-ray machine. Beatriz Colomina draws an analogy between the exposure of interior space in transparent glass buildings of early 1900s with exposure of internal organs in an x-ray, an 1895 invention that had become common in treatment of tuberculosis. She writes, "Screening the body for tuberculosis meant penetrating with the gaze areas of the body previously invisible."¹⁵ At Zonnestraal, this gaze penetrates two layers of skin: through the transparent envelope of the building and, with x-rays, through the patient's bodies.

There were also questionable forms of light therapies from this era. Doctor John Harvey Kellogg, a Seventh-Day Adventist and an active writer for the church publication *Health Reformer*, advocated for temperance, vegetarianism, and the use of natural remedies, including light therapies. He became the superintendent of Battle Creek Sanitarium in Michigan, where he invented exercise machines and the Kellogg corn flakes.¹⁶ His phototherapy manual includes advertising images for his company. In a photomontage entitled *Arc Light to the Chest*, a ray of light from a lamp is aimed at the smiling model's chest but the light shines right through her, unobstructed by the body.¹⁷ In 1891, Kellogg invented the incandescent light bath, which he claimed would cure a host of ailments, from diabetes, obesity, to chronic gastritis.¹⁸ Some examples of light therapy such as these suggest that today's theories of cures should also be approached with skepticism and scrutiny.

ELECTRIC LIGHT

Although the explicit reference to light in the sanatorium was limited to the sunlight, the role of electric light deserves examination. Following the 1879 invention of Edison's commercialized incandescent light bulb, the first three decades of the 20th century experienced an incredible growth in adoption of electricity. In 1906, less than eight percent of U.S. households had electricity. By 1929, it had reached about 85 percent.¹⁹ In 1903, Niels Finsen won a Nobel Prize for his work on treatment of lupus with artificial light. Zonnestraal was designed in the context of such discoveries that gave hope for the future in electric light.

Before electricity, city streets and interior were dimly lit by candle or gas light. In rural areas without gas street lamps, buildings became nearly invisible at night. However, with mass production of artificial light, the interior became visibly exposed to the outside. Reyner Banham observes that this flips Le Corbusier's definition of architecture, "Architecture is the masterly, correct and magnificent play of masses brought together in light." Banham writes, that with an illuminated glass building in the nighttime, "it is no longer a question of form in light, but of light in forms."²⁰

At the time of Zonnestraal's construction, the knowledge of electrical technology was limited. The number of light fixtures was very low by today's standards. A typical dwelling had one central point of power.²¹ At Zonnestraal, control over electrical light quantity and quality was likewise limited. With sometimes a single fixture to illuminate a room, the light level was about 75 lux. Today's illumination standards would require twice to three times the fixtures.²² Even so, the sanatorium would have shined like a lantern in the dark, forested estate, exhibiting a striking contrast between nature and new artificial culture.

LESSONS FROM ZONNESTRAAL

There are contemporary lessons to be learned from Zonnestraal. On the one hand, despite the visionary design intent aimed for human wellness, the building's adherence to modern principles resulted in spaces that did not bring about human comfort. The expansive glass

windows resulted in an over- or under-heated interior. As with many modern buildings of this era, thermal breaks in the glass curtain walls were poor by today's standards. These technical limitations, as well as images of heliotherapy from the early 1900s, remind us today to approach with caution the claims of scientifically proven solutions in building designs.

On the other hand, there is an uplifting spirit in Zonnestraal: the expansive glass and the framing of the views of the forest beyond, the baby blue and light yellow interior that bring the colors of the sky and sunlight into the room, and, above all, the utopian conviction in architecture's healing power. Thermal comfort may be compromised by today's standards, but the building should not be dismissed simply for what appear to be technical failures. In fact, Duiker was fully aware that this building's ephemeral destiny and did not design for permanence.²⁴ The spirit it embodies could be more beneficial to the patients' well-being than many of today's LEED certified buildings that are energy efficient but are limited in spirit that lifts the soul.

Gerrit Rietveld, trained as a furniture designer, attempted to define this complex *Nieuwe Bouwen* aesthetic in the magazine *i10*. He cites the curved legs of Louis XV chair and the Dutch bombe chest, "where technical principle had led to the beautiful form."²⁴ Rietveld believed that in modern times as well as in Louis XV's, techniques specific to its time can result in beautiful aesthetics. His belief was less dogmatic than Theo van Doesburg's view which strongly directed the tenets of De Stijl—that "the optical-aesthetic needs of man are satisfied by the angular townscape rather than by the picturesque and irregular forms of nature."²⁵

Others including Oud and Duiker were less rigid; Oud compared architecture to nature and called it "in a deeper sense (...) organic..."²⁵ Duiker's position on nature and spiritual economy is apparent in this conversation between H.P. Berlage and Duiker. Berlage said, "'Zakelijkheid (objectively) should not mean 'as fast and cheaply as possible' but should rather be taken as 'spiritual economy in place of financial economy.' Such spiritual economy will lead to economic construction in the materials used..." He further said that in Duiker's work, "inspiration, intuition, architectural capacity, have led you to the furthest technical extreme and at that point spiritual values are missing." To this criticism, Duiker responded,

...The strongest prime impulses live[s] in us in every cultural expression, in science and in every natural phenomenon. This inspiration is valuable for it follows the laws of economy. Nature itself demonstrates this cosmic law...Often financial and spiritual economy go hand-in-hand to make all these achievements possible, but the result we see before us is solely the work of the spirit.²⁷

CONTEMPORARY PRACTICE AND A CALL FOR A NUANCED APPROACH TO LIGHT

Like superstitious beliefs, once drugs nearly eradicated tuberculosis, the belief in architecture as a means of healing through light and air exposure evaporated after World War II. Unlike the effects of drugs,



Fig 5 Broken Light in Rotterdam by Rudolf Teunissen. Courtesy of Daglicht en Vorm.

the healing impact of a building—designed with care for how it brings in light, how it exposes the inhabitants to light, view, and air—is difficult to quantify.

The period in which modern architects praised the healing power of sunlight also coincides with the emergence of torture methods through electric light. Stalin’s police sleep-deprived prisoners through continuous exposure to electric light until they confessed in a state of helplessness. These observations suggest that, in a world highly mediated by artificial light, human interventions are necessary to attune light exposure.

Today, there is an increasing need for a more nuanced approach to light exposure, one that recognizes a need for a new attitude in today’s artificially mediated environment that too often disconnects us from the natural solar cycle. Prior to industrialization, human sleep and work were in synch with the sun. Farmers’ work began with sunrise and stopped when the sun came down. Electric light made work after sunset possible, resulting in what Jonathan Crary calls a “radical reconceptualization of the relation between work and time.”²⁹ It expanded economic activities beyond daylight time to all times of the day. The design potentials of electric light in for cities and buildings effectively remained untapped during the mid 1900s. For over a century, the Edison bulb design was practically unaltered.

The past two decades have witnessed a surge in intelligent light control, LEDs of remarkable brightness and color capabilities, and optical films that direct light with extraordinary precision. Streetlight controls can now respond to weather conditions or changes in surrounding surface materials, and roadways can automatically dim illumination level when the traffic flow decreases.³⁰ In contemporary practice, limited capabilities of lighting in the last century are today’s opportunities for more nuanced lighting schemes, those better attuned to both human bodies and the solar cycle.

A lighting project for public space in the Netherlands provides insight into potentials of finely calibrated light. In 2006, the city of Rotterdam launched an initiative to revitalize a run-down neighborhood near its port. One of the commissioned light projects was Broken Light by Rudolf Teunissen of the firm Daglicht en Vorm (*Daylight and Form*). The project makes a case for carefully attuned light exposure for varying locations, purposes and atmospheres, all layered in the same space of Atjehstraat. Eighteen light poles throw non-uniform, tailored patterns onto the sidewalk and the building facades. The illumination on the façade is carefully calibrated: vertical stripes of light are projected on walls between the windows but avoid shining directly into the windows of sleeping inhabitants. The sidewalks receive human-scaled dabbled light while the roads are lit uniformly for drivers.³¹

Although modern architects wrote relatively little on how electric light may impact architecture and cities, visionary bohemian poet Paul Scheerbart contemplated on the potentials of subdued lighting with electric bulbs. In his 1914 *Glasarchitektur*, he writes, “It must be repeated that efforts should not be directed towards achieving greater brightness in lighting, for we have got that already. We should think all the time of softening of light in choosing colours.”³² His writing on streetscape is a foretelling critique of today’s roads that have become uniformly lit for automobiles and not people:

If we must mention something detestable, this is, in my view, those street lamps which in every town look so alike that one cannot help wondering how mankind can be capable of such monotonous repetition. Happily, this repetition can be quickly eliminated by combinations of coloured glass hanging-lamps, which are adaptable to a vast number of forms. This elimination will of course come very soon.³³

His time prediction was inaccurate, but his advice was astute and remains valuable.

CONCLUSION

Sanatorium Zonnestraal is an instrument of exposure from a particular time, a period filled utopic conviction that architecture will bring social change and heal ailments. The success of drug therapy as well as the end of world wars contributed to suspension of belief in healing powers of architecture. Revisiting Zonnestraal over eighty years later, we may once again find optimism in architecture—one that not only lets in, as in the words of Paul Scheerbart, “the light of the sun, the moon and the stars,”³⁴ but also synthesizes it with finely attuned, responsive electric light that brings us closer to nature.

ENDNOTES

- 1 Margaret Campbell, “What Tuberculosis did for Modernism,” *Medical History* 49 (2005), 487.
- 2 Paul Overy, *Light, air & openness: modern architecture between the wars* (London: Thames & Hudson, 2007), 14.
- 3 Overy, 22.
- 4 Overy, 15.
- 5 Erik Mattie, *Functionalism in the Netherlands* (Amsterdam: Architecture & Natura, 1995), 6.
- 6 *Ibid*, 13.
- 7 Beatriz Colomina, “Medical Body in Modern Architecture,” in *Anybody*, ed. Cynthia Davidson (Cambridge, MIT Press, 1997), 231.
- 8 Bruno Reichlin, “The original splendour regained,” in *Sanatorium Zonnestraal: the history and restoration of a modern monument*, ed. Paul Meurs and Marie-Thérèse van Thoor (Rotterdam: nai010, 2011), 239.
- 9 Overy 19.
- 10 Alison and Peter Smithson, *The Heroic Period of Modern Architecture* (New York: Rizzoli, 1981), 42.
- 11 Overy, 9.
- 12 “Heliotherapy - light therapy,” Science Museum, London, accessed September 10, 2016, <http://www.sciencemuseum.org.uk/broughttolife/techniques/heliotherapy>.
- 13 Eveline Dickinson, “The Finsen Light Treatment for Lupus,” in *American Journal of Nursing*, Vol. 2, No. 9 (Jun., 1902), 658-660.
- 14 Smith, John. *Encyclopaedia Britannica*, “Niels Ryberg Finsen.” Chicago: Encyclopaedia Britannica, 2016. <https://www.britannica.com/biography/Niels-Ryberg-Finsen> (accessed September 21, 2016).
- 15 Beatriz Colomina, “Undisturbed,” in *Sanaa: Kazuyo Sejima, Ryue Nishizawa - Intervention in the Mies van der Rohe Pavilion*, ed. Xavier Costa (Barcelona: ACTAR, 2010), 24.
- 16 “Dr. John Harvey Kellogg – Inventor of Kellogg’s Corn Flakes,” University of Texas San Antonio Health Science Center, San Antonio, accessed September 16, 2016. <http://library.uthscsa.edu/2014/05/dr-john-harvey-kellogg-inventor-of-kelloggs-corn-flakes/>
- 17 Arc light to the chest, photomontage, 2nd ed, in *Light therapeutics: a practical manual of phototherapy for the student and the practitioner* / John Harvey Kellogg. 2nd ed. Battle Creek, Mich.: Modern Medicine Pub. Co., 1927. (opp. p.108) Private collection.
- 18 Sarah Laskow, “John Harvey Kellogg Believed Light Could Cure Diabetes,” *Atlantic*, accessed September 15, 2016. <http://www.theatlantic.com/health/archive/2014/12/john-harvey-kellogg-believed-light-could-cure-diabetes/382916/>
- 19 “The Gadgets of the Future from the Electrical Shows of Yesterday,” *Smithsonian*, Washington, DC, accessed September 16, 2016. <http://www.smithsonianmag.com/history/the-gadgets-of-the-future-from-the-electrical-shows-of-yesterday-825757/?no-ist>
- 20 Reyner Banham, “Edison, Missing Pioneer,” *Daidalos* 27 (1988): 52.
- 21 Wessel de Jonge, “Nieuwe Bouwen in Practice,” in *Sanatorium Zonnestraal: the history and restoration of a modern monument*, ed. Paul Meurs and Marie-Thérèse van Thoor (Rotterdam: nai010, 2011), 119.
- 22 Wessel de Jonge and Hubert-Jan Henket, “The Restoration,” in *Sanatorium Zonnestraal: the history and restoration of a modern monument*, ed. Paul Meurs and Marie-Thérèse van Thoor (Rotterdam: nai010, 2011), 194.
- 23 Wessel de Jonge, “Zonnestraal: Restoration of a transitory,” *Proceedings of the Seventh International DOCOMOMO Technology Seminar at Viipuri Library, Vyborg, Russia, 2003*, accessed October 26, 2016. http://www.wesseldejonge.nl/media/downloads/Zonnestraal_project%20ENG.pdf
- 24 Mattie, 25.
- 25 *Ibid*, 24.
- 26 *Ibid*, 25.
- 27 *Architectural Forum*, 1 (1962), quoted in Robert Vickery, “Bijvoet and Duiker,” *Perspecta* 13/14 (1971): 156-157. The original source cited did not contain the attributed quotation.
- 28 *Ibid*, 6.
- 29 Jonathan Crary, *24/7: Late Capitalism and the Ends of Sleep* (London: Verso, 2013): 62.
- 30 Sandy Isenstadt, “Good Night: A dazzling new era of metropolitan light,” *Places*, accessed September 16, 2016. <https://placesjournal.org/article/good-night/>.
- 31 Tracy Metz, “Broken Light,” *Architectural Record*, accessed October 15, 2016. <http://www.architecturalrecord.com/articles/7673-broken-light>
- 32 Paul Scheerbart and Bruno Taut, *Glass Architecture*, by Paul Scheerbart; and *Alpine Architecture*, by Bruno Taut, ed. Dennis Sharp (New York: Praeger, 1972): 65.
- 33 *Ibid*, 68.
- 34 Tim Benton, Charlotte Benton, and Dennis Sharp. *Architecture and Design, 1890-1939: An International Anthology of Original Articles* (New York: Whitney Library of Design, 1975): 73, quoted in Paul Overy, *Light, air & openness: modern architecture between the wars* (London: Thames & Hudson, 2007), 7-8.