“With-On” White: Inconspicuous Modernity with and on Aesthetic Surfaces, 1910–1950

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The whitest white: Interior of the titanium dioxide factory Kronos Titan AS, in Fredrikstad, Norway. Marte Johnslien, 2019.

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PROJECT
Toxics

In 1910, a Norwegian chemist gazed through a microscope to study a white substance (**fig. 1**). He observed something about this white that was different from other pigments. As part of a large-scale, state-funded laboratory experiment, various pigments had been placed under the microscope:

ocher, red iron oxide, black iron oxide, and the chemist's own innovation, the titanium pigment. The microscope magnified the dry, textural substances, and then a photomicrographic camera produced eight images (**fig. 2**). The photomicrograph of the iron pigment showed a spiky and dramatic texture, the ocher pigment had an almost smooth surface, and the titanium pigment displayed regulated properties; the spots of shadows revealed an uneven but flat mass. The titanium pigment was, however, remarkably shimmering and opaque, the chemist noted in his notebook: "Compared to a finer French ocher, titanium color shows that practically the same light shade has a superior opacity… . In other words, the opacity of a titanium color is about five times that of the ocher."[1]

Perhaps, even, as the scientist scrutinized the flat surfaces in the microscope, the laboratory environment might have seemed to fall away.

Fig. 1. Photomicrograph of titanium pigment, found in Peder Farup's notebooks from September 1910. Farup's Archive, the Norwegian Mining Museum.

The light, grainy circles on the black background united two different scales. On a micro level, the chemist gazed into a world of minerals that naturally exist in mountain ores deep beneath the ground. On a macro level, the light, textured spheres with dark spots against the black background evoked an almost extraterrestrial world—like the popular photos of the full moon that then circulated in the printed press—brought closer by a telescope. The neutralized zone of the black-and-white photomicrographic medium captured the various pigments' textural properties, and for the titanium pigment the apparatus zoomed in and made visible the grains of a substance whose material purpose was to hide the surface that lay beneath and at the same time to not be noticed itself.

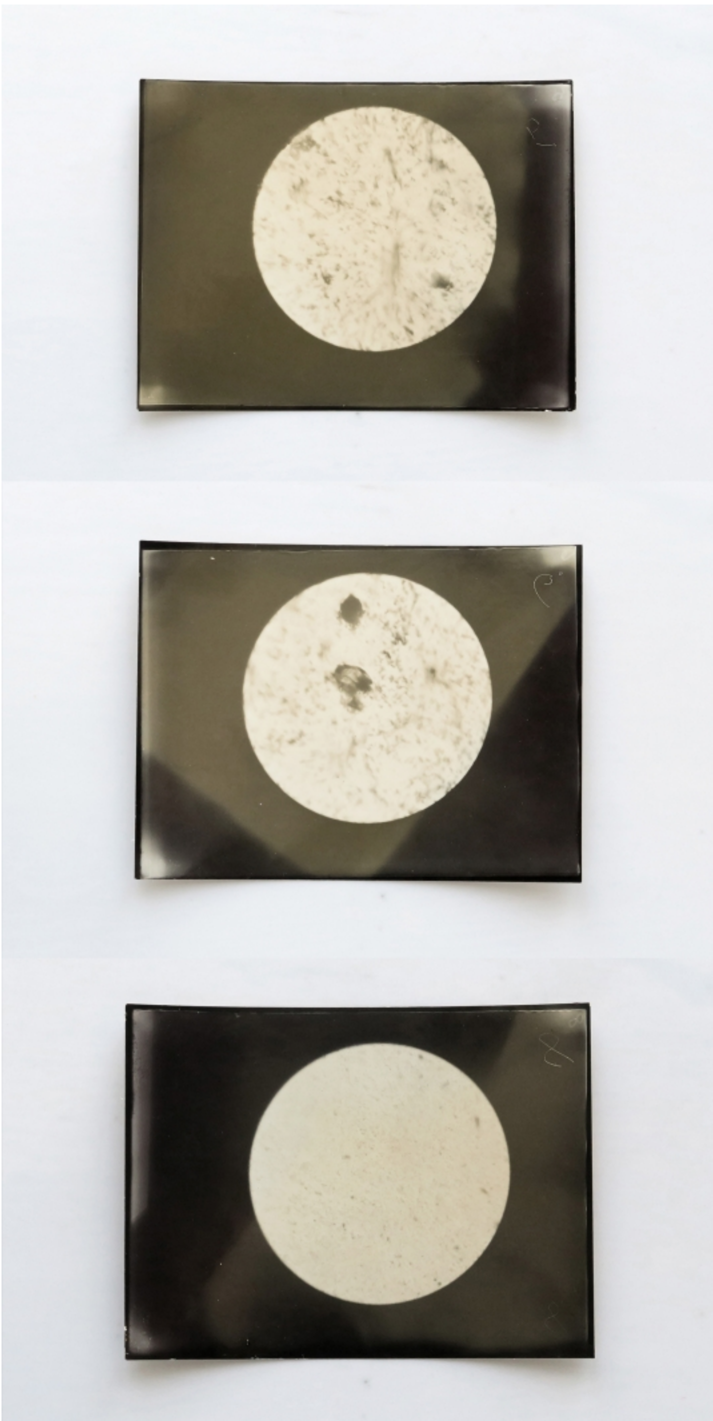


Fig. 2. Three photomicrographies of pigments. From top: black iron oxide ocher, red iron oxide, and ocher. Peder Farup's notebooks from September 1910. Farup's private archive, the Norwegian Mining Museum.

The chemist was probably unaware of the far-reaching implications the titanium pigment would have on the environment in the coming century. Most likely, he was also unaware of the impact a smooth white surface would have on architectural discourse in the decades to come.[2] The Goldman and Salatsch Building in Vienna, designed by Adolf Loos, was under construction when the Norwegian chemist filed his first patent for the process that produced titanium white. The pigment was later described as the "whitest white" or "absolute white," due to its pure tone, stability, resistance to natural and chemical influences, and ability to hide the substance underneath. Just months apart, two groundbreaking events related to white as a color—the "death of the ornament" and the birth of the whitest white—laid the foundation for modernism's aesthetic transformation of physical environments.[3] Yet, while the ornament's death belongs to the iconic history of architectural modernism, the material histories of this birth of the whitest white are underexamined in architectural history.[4] The event is as inconspicuous as the pigment's essential material and visual properties. Both events, however, inaugurated a new stage in aesthetics in which the color white would be associated with progress and cleanness, exemplified by Le Corbusier's account of Loos's essay as having provided "a Homeric cleaning up" of architecture, one that was "precise, philosophical, and logical."[5]

Nevertheless, the white paint that Le Corbusier and other early modernists used was later understood as toxic and not, in fact, all that pure.[6] Toxic lead-based paint was the only white paint used in Europe until the start of the twentieth century, when its manufacture became restricted.[7] Zinc white was the only alternative to lead white, but it could not compete with the toxic pigment when it came to brightness and density. After the ban on lead oxide, bright white paint did not exist.[8] It was not until the Norwegian chemist Peder Farup (1875–1934) and the chemist and industrialist Gustav Jebsen (1861–1923) discovered a chemical method for separating iron and titanium that the technological conditions for producing a pure white paint were engineered into reality. The production of titanium white was based on Farup and Jebsen's technological innovations and breakthroughs in chemistry from 1910 to 1920. The most notable of those achievements were their development of a method for manufacturing the inorganic chemical compound titanium dioxide and their "sulfate process," which today is still the most widely used process for producing titanium dioxide. The patent for titanium dioxide (TiO_2) manufacture allowed for the development of the titanium white pigment, which revolutionized the color industry by bringing onto the market a pure white, *nontoxic* paint that resisted discoloration due to dirt and rust. However, even though TiO_2 was not—at the time—considered chemically toxic, it created conditions for the emergence of attitudes toward color that could be said to be socially toxic. These attitudes allowed hierarchies and dichotomies such as clean/filthy, modern/ nonmodern, and civilized/primitive to materialize in everyday surfaces.

During the 1930s and 1940s, titanium white—the inorganic chemical compound TiO_2—was increasingly used in combination with other materials, thereby changing the aesthetics of surfaces in architecture and design. Its excellent covering ability made surfaces smoother, brighter, and more opaque. From white walls to systemic spread, today TiO_2 circulates extensively through our material, biological, and economic systems, most of the time completely unnoticed. The inorganic compound is in the food we eat and the paper on which we print. It is in the paint on the wall, as well as in concrete coatings, synthetic textiles, tattoos, cosmetics, sunscreens, and in endless amounts of white plastic products. Currently TiO_2 is present in literally every part of modern life.

In both art and architecture, white and whiteness encompass numerous aesthetic, stylistic, and societal debates.[9] In *Race and Modern Architecture*, Irene Cheng, Charles L. Davis II, and Mabel O. Wilson define the white walls of modernism as a constitutive site for racial thought. They write that "racial thought persisted in twentieth-century architectural modernism in concepts such as evolution, progress, climatic determination, and regionalism, even as these became separated from their origins in racial discourse and subsumed in the broader ideology of internationalism and color-blindness embodied by modernism's white walls."[10] In the essay "Chronic Whiteness" from 2020, Mark Wigley discusses what he calls "the violent laws of whiteness" and shows how modernism's desire for white surfaces cleared the ground for cultural racism, ideas about white superiority, and the chromophobic exclusion internalized in architectural aesthetics. Still, Wigley stresses, "architecture's whiteness … is not the white surfaces that accentuate any pigment or pattern added to them. The real whiteness of architecture is in its systematic exclusions and subordinations, its regimes of privilege."[11] In the present article, rather than focus on the visual effects of the white color, we hope to deepen this insight by questioning the material history of the color—

even the whitest white—in order to locate the conflicts and paradoxes of whiteness within the material itself.

In an effort "[to] look to the heart of the canon," as Cheng, Davis, and Wilson put it, "deconstructing that which appears universal, modern, and transparent," we detail the unknown history of how the discovery, innovation, and marketing of the "whitest white"—and its subsequent integration into coatings, plastics, paper, and cosmetic products—visually and materially promoted epistemic notions of inconspicuousness, durability, and homogenization into and onto objects and environments.[12] The chemical substance championed for its nontoxic properties thus materially inscribed a *latent toxicity* of inconspicuous modernity in and on our world. The origin of this inconspicuousness is the invention of the pigment titanium white, which paradoxically embodies a darker matrix of socially toxic dimensions. In the words of Walter Mignolo, when he defines the word *coloniality*, there is a "reverse and unavoidable side of 'modernity'—[a] darker side, like the part of the moon we do not see when we observe it from earth."[13]

From Hydropower Surplus to Media Circulation

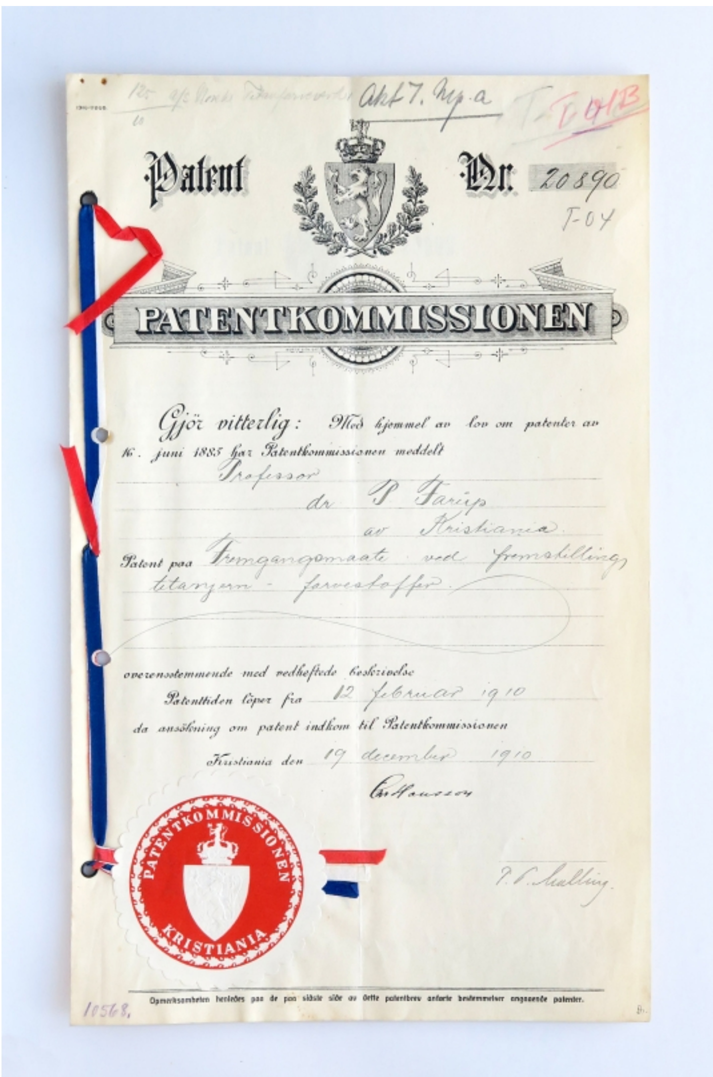
In 1864, the Norwegian Titanic Iron Ore Company bought the mining rights to a geologically complex area close to Jøssingfjorden in Rogaland, Norway, that was rich in ilmenite—a black titanium-iron mineral. The mine was relatively unprofitable until the company Elektrokemisk Industri (today called Elkem) became interested in the mining waste, namely titanium. Elektrokemisk was founded in 1904 with the goal of creating an international industrial company based on Norwegian natural resources. In the early 1900s, an ethos of technological optimism dominated the young nation-state (Norway gained independence from Sweden in 1905). The optimism was largely the result of path-breaking technological innovations in hydroelectric power that had boosted the rather poor country's capability for industrial production. The Norwegian Ministry of Trade joined forces with Elkem in 1907, and a special committee for electrometallurgy was appointed to evaluate the unprofitable ilmenite ore in Jøssingfjorden, the aim being to utilize surplus energy from the area's recently built dams and hydropower plants (**fig. 3**).

Fig. 3. Nedre Helleren hydropower plant from 1907. Jan Ove Grastveit.

When Dr. Farup was hired as a professor of inorganic chemistry at the recently founded Norwegian Institute of Technology (NTH), his mandate involved "bridging, even mixing, industrial and academic realms."[14] Simultaneously to being hired as a consultant for Elkem, he was appointed to the State Committee for Electrometallurgy together with a geologist and a metallurgist from NTH. The historian of chemistry Annette Lykknes has detailed how Farup's cross-sectoral undertakings (public university, private enterprises, and state-led, mission-oriented innovation) harmonized with national and economic optimism:

> When NTH was founded, Norway was still young and bursting with national pride. In 1896 the scientist and explorer Fridtjof Nansen was celebrated as a national hero upon his return from his polar expedition to the Arctic and became a symbol of what the new nation state could achieve. It was an era of optimism, not only because of the country's recently gained independence, but also because of the belief that its prosperity would be based on knowledge production and industrial development. The establishment of NTH coincided with the emergence of a large-scale Norwegian industry based on hydro-electric power, and the utilisation of ore and metal smelting as well as electrochemistry were [*sic*] considered particularly promising.[15]

From the very outset, the mandate of the state committee had been to maximize profits in unprofitable iron mines. Based on Farup's recommendations, the committee soon focused its attention on mining waste. After Farup's initial analysis of titanium-rich iron ore from Sokndal, he was convinced that "in future color production, we can use waste products that up until now have had no value whatsoever."[16] The chemical experiments started in 1909, and although the earliest ones focused on titan yellow and titan red pigments, Farup's ultimate goal was to utilize "titanium-containing waste from iron mines … that could produce a white color."[17] Although chemists at the National Lead Company in the United States were also conducting experiments for producing pigments from titanium-containing iron ores, in 1910 Farup filed the first patents (both a Norwegian patent and a US patent) for coloring matter from titanium-iron minerals (**figs. 4 & 5**). In 1912–13, Farup decided to concentrate the experiments solely on the color white.


Patent Nr. 20890

PATENTKOMMISSIONEN

Gjör vitterlig: Med hjemmel av lov om patenter av 16. juni 1885 har Patentkommissionen meddelt Professor dr P Farup av Kristiania

Patent paa Fremgangsmaate ved fremstilling av titanjern - farvestoffer

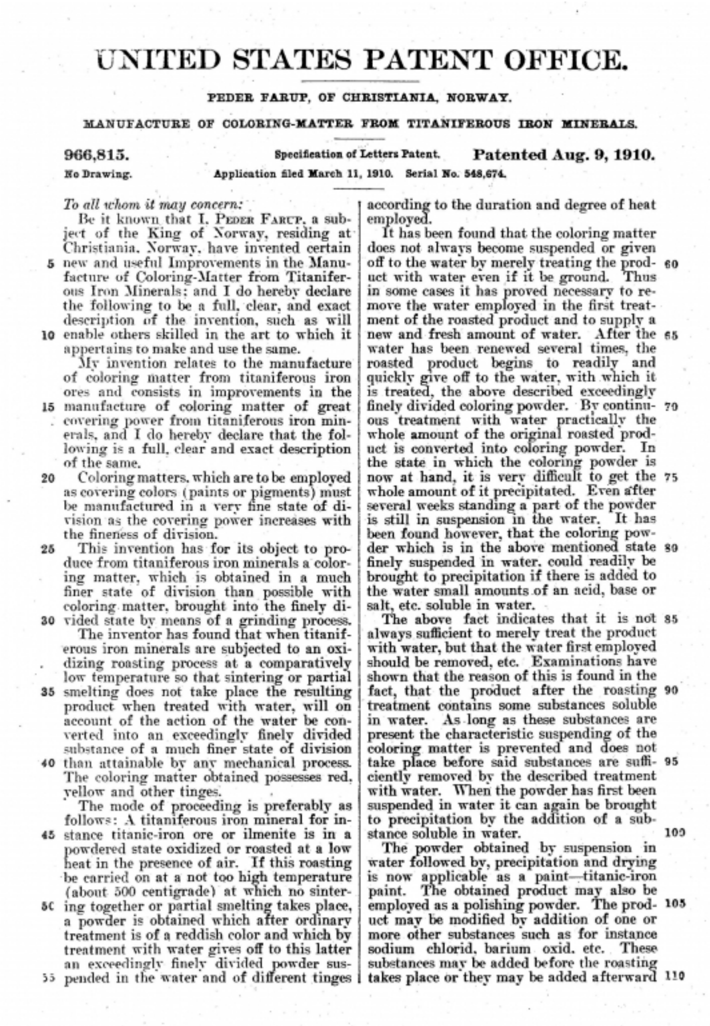
overensstemmende med vedheftede beskrivelse

Patenttiden löper fra 12 februar 1910 da ansökning om patent indkom til Patentkommissionen

Kristiania den 19 december 1910

PATENTKOMMISSIONEN KRISTIANIA

Fig. 4. Peder Farup's first Norwegian patent for the production method of titanium colors (April 1910). Farup's archive, the Norwegian Mining Museum.



UNITED STATES PATENT OFFICE.

PEDER FARUP, OF CHRISTIANIA, NORWAY.

MANUFACTURE OF COLORING-MATTER FROM TITANIFEROUS IRON MINERALS.

966,815. Specification of Letters Patent. Patented Aug. 9, 1910.

No Drawing. Application filed March 11, 1910. Serial No. 548,674.

To all whom it may concern:

Be it known that I, Peder Farup, a subject of the King of Norway, residing at Christiania, Norway, have invented certain new and useful Improvements in the Manufacture of Coloring-Matter from Titaniferous Iron Minerals; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the manufacture of coloring matter from titaniferous iron ores and consists in improvements in the manufacture of coloring matter of great covering power from titaniferous iron minerals, and I do hereby declare that the following is a full, clear and exact description of the same.

Coloring matters, which are to be employed as covering colors (paints or pigments) must be manufactured in a very fine state of division as the covering power increases with the fineness of division.

This invention has for its object to produce from titaniferous iron minerals a coloring matter, which is obtained in a much finer state of division than possible with coloring matter, brought into the finely divided state by means of a grinding process.

The inventor has found that when titaniferous iron minerals are subjected to an oxidizing roasting process at a comparatively low temperature so that sintering or partial smelting does not take place the resulting product when treated with water, will on account of the action of the water be converted into an exceedingly finely divided substance of a much finer state of division than attainable by any mechanical process. The coloring matter obtained possesses red, yellow and other tinges.

The mode of proceeding is preferably as follows: A titaniferous iron mineral for instance titanic-iron ore or ilmenite is in a powdered state oxidized or roasted at a low heat in the presence of air. If this roasting be carried on at a not too high temperature (about 500 centigrade) at which no sintering together or partial smelting takes place, a powder is obtained which after ordinary treatment is of a reddish color and which by treatment with water gives off to this latter an exceedingly finely divided powder suspended in the water and of different tinges according to the duration and degree of heat employed.

It has been found that the coloring matter does not always become suspended or given off to the water by merely treating the product with water even if it be ground. Thus in some cases it has proved necessary to remove the water employed in the first treatment of the roasted product and to supply a new and fresh amount of water. After the water has been renewed several times, the roasted product begins to readily and quickly give off to the water, with which it is treated, the above described exceedingly finely divided coloring powder. By continuous treatment with water practically the whole amount of the original roasted product is converted into coloring powder. In the state in which the coloring powder is now at hand, it is very difficult to get the whole amount of it precipitated. Even after several weeks standing a part of the powder is still in suspension in the water. It has been found however, that the coloring powder which is in the above mentioned state finely suspended in water, could readily be brought to precipitation if there is added to the water small amounts of an acid, base or salt, etc. soluble in water.

The above fact indicates that it is not always sufficient to merely treat the product with water, but that the water first employed should be removed, etc. Examinations have shown that the reason of this is found in the fact, that the product after the roasting treatment contains some substances soluble in water. As long as these substances are present the characteristic suspending of the coloring matter is prevented and does not take place before said substances are sufficiently removed by the described treatment with water. When the powder has first been suspended in water it can again be brought to precipitation by the addition of a substance soluble in water.

The powder obtained by suspension in water followed by, precipitation and drying is now applicable as a paint—titanic-iron paint. The obtained product may also be employed as a polishing powder. The product may be modified by addition of one or more other substances such as for instance sodium chlorid, barium oxid, etc. These substances may be added before the roasting takes place or they may be added afterward

Fig. 5. Peder Farup's first American patent for the production method of titanium colors (August 1910). United States Patent Office.

The documents that describe this history were found in Peder Farup's unclassified private papers—stowed away in forgotten boxes in a mountain storage facility deep within the Kongsberg Silver Mines—belonging to the Norwegian Mining Museum. Farup's laboratory notebooks, found in these boxes, reveal that a small team of chemists and technicians conducted systematic experiments for six years, the aim being to perfect a white pigment with a high covering capacity. Over and over, the team tested different heating temperatures, flotation and separation technology, and various chemical additives, and they experimented with the percentage of pure titanic acid. Again and again, they returned to the microscope to study the new result: paint on a flat surface. How many coats of paint were needed to cover the surface beneath? Could the paint be applied smoothly? How quickly did it dry? Gustav Jebsen later gave an account of their early experiments: "The most interesting result … was that during these works we found that pure titanium acid, which is known to be white, turned out to be in possession of a very high covering power when suspended in oil."[18]

After years of experiments, reports, mistakes, and patents, the production of titanium white for the global market began in 1916 when the mining company Titania AS in Sokndal, Norway, began the mass exploitation of ilmenite (titanium iron ore).[19] That was the year that the factory Titan Co.—funded by the industrialist Sam Eyde and Elkem and led by Dr. Jebsen—was established in the city of Fredrikstad, Norway. The sister companies Titania AS and Titan Co. were the first industrial manufacturers of titanium white, and their work marked the start of a world industry: the international pigment industry based on the sulfate process for mass-producing a nontoxic, pure white paint.

In an internal report from 1918, Titan Co. expressed certitude that its new pigment would outperform both zinc white and lead white in a relatively short time: "1) The opacity is greater than in both lead white and zinc white and its opacity is at least twice as great as zinc white. 2) It is whiter than any of these 3) it is non-toxic and contains no harmful constituents, so that it is completely harmless… 5) Its resistance to the effects of sunlight, water—fresh and salt—and atmospheres (acid and acid gases) is very high."[20] Titanium white creates a hermetic layer that, with its supreme covering ability, protects against environmental impact. The pigment's high opacity, which contributes to its ability to cover irregular surfaces, hide dirt, and protect against seasonal variations, might be considered a property that conflicts with the idea of a maximum white color that strives for physical and symbolic transparency, absence, and withdrawal. However, this paradox of inconspicuousness is the most essential material and visual property of titanium white, and when the product was launched on the market, the paradoxical inconspicuousness spread across the young nation in the next phase of the large-scale innovation project, namely a wide circulation of advertisements and publicity stunts. Ironically enough, this project became more visible than the product itself.

"Paint for the North Pole!" Titan Co. announced in connection with its first spectacular public relations campaign only a few years after titanium white was launched; the company teamed up with the polar explorer and national celebrity Roald Amundsen to paint his new polar ship *Maud* bright white.[21] "Knowing full well the severe conditions to be encountered in the Arctic regions and realizing the importance of having his ship protected in the best possible manner, [Roald Amundsen] thoroughly investigated this question. As a result, he had his ship painted with titanium white before sailing for the North Pole in 1918," Titan Co. proudly states in a brochure produced for English-speaking markets.[22] Amundsen's ship was not only the perfect vessel to display the paint's resilience against the extreme climatic conditions; the vivid, bright white also carried connotations of scientific innovation, optimism, and progress while at the same time visually mimicking the Arctic ice. The titanium-white polar ship thus became an emblem of the scientific territorialization of the Arctic region, and national pride ideologically underpinned its bright aspect. And, according to Titan Co.'s own advertisements, "captains report … that titanium white paint in [an] extraordinary way withstands rapid changes of temperature. The burning sun of the tropics does not discolor it, does not cause it to dry up."[23] From the tropics to the Arctic: ever since its industrial inception, the whitest white came to be included in a traveling narrative, almost predicting the material's forthcoming status as a global presence, with wide circulation across the planet.

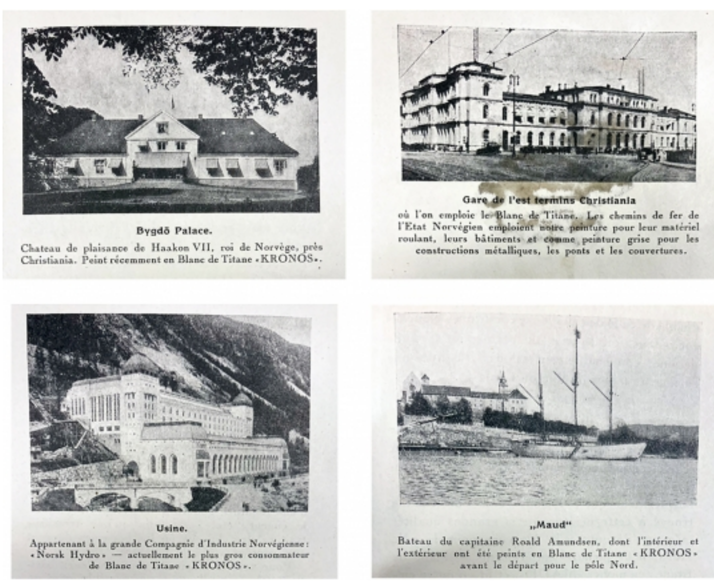


Fig. 6. Building a white national identity, ca. 1920. Buildings painted with 'Kronos' Titanium White. Top: Bygdøy Royal Farm; and Oslo East Railway Station. Bottom: Såheim Hydroelectric Power Station; and the polar ship *Maud* commissioned by the Arctic explorer Roald Amundsen.
Kronos Titan's archive, Østfoldmuseene.

In an advertising brochure published in Norwegian, English, French, German, and Dutch, Amundsen's white ship is pictured together with other publicity shots of places that had received the titanium white treatment: the Oslo East Railway Station, as well as the main house on the Norwegian royal family's farmed estate at Bygdø in Oslo, and the monumental, newly built Såheim hydroelectric power station (1916) in the company town of Rjukan (built by Norsk Hydro, a fertilizer company also founded by the industrialist Sam Eyde) (**fig. 6**). Yet, despite the first endeavors to promote the product, consumers in both national and international markets remained hesitant to buy Norway's new paint.[24] A change in the marketing strategy occurred in 1920, when Titania AS and Titan Co. directed their publicity toward homeowners, inviting them to use the paint indoors as well as on the exterior of private houses. "Paint Is Economy" (Maling er økonomi) was the slogan used in an advertisement appearing in the newspaper *Aftenposten* in 1920 (**fig. 7**).

Fig. 7. "Paint is Economy," *Aftenposten*, March 4, 1920.

Documents in the archive of Kronos Titan (the current name of Titan Co.) attest to a large investment in scientific experiments in which titanium white was tested on Norwegian traditional wooden houses. The potential market for house paint in Norway was, after all, vast. Forests cover about thirty-eight percent of the land area, and since the country had a prosperous timber industry at the time, Norway's vernacular architecture differed remarkably from European building traditions in which masonry, brick, and concrete were the most common building materials.[25] Norway's natural resources, by contrast, provided materials for handcrafted, tar-covered log buildings (made with the so-called Scandinavian full-scribe technique) as the emblematic vernacular architecture, and following the invention of the steam-powered circular saw and machine-profiled panel techniques, there was growth in the demand for paint as a protective layer against harsh climatic conditions.[26]

The results of Titan Co.'s scientific experiments on wooden surfaces revealed that titanium white created a hermetic barrier that both interrupted the decaying processes (due to fungi and rot) in wooden planks and protected the wood from external deterioration (caused by humidity and sunlight). A journalist who visited Titan Co.'s factory in Fredrikstad in 1919 observed how fragments of black ilmenite went through tubes, ovens, pipes, mills, and chemical containers and were transformed into a white, smooth, and sticky paste. He described the process as an "epoch defining event." In his article "The New Norwegian World Product Titanium White," he describes how the sticky titanium would "completely penetrate the wood surface and enter into an organic relationship with it so that it doesn't crack."[27] The process can be described by borrowing a description of Omo brand detergent offered by Roland Barthes: "[soap-]powders . . . are separating agents: their ideal role is to liberate the object from its circumstantial imperfection: dirt is 'forced out.'"[28] Yet, instead of *penetrating* the object to remove environmental traces, as in Barthes's whitewash analysis, titanium white on wood surfaces constructs a stable and durable barrier that segregates the object from its natural environment by the means of an invisible, hermetic surface of absolute white. Moreover, the inorganic pigment constructs this barrier by entering into a relationship with the underlying organic material, thus forming a laminate layer that halts organic processes by merging with them. If "paint is economy," titanium white creates an *organic-inorganic* agent of resilient maximization.

From Corporate Identity to Colonial Gestures

As an effect of increased market demand, the extraction and production of titanium white also commenced outside Norway. In the early 1920s, the National Lead Company, in its facilities at Niagara Falls, New York, produced a white paint made from titanium pigments. It was based on patents rather similar to those held by Farup but involved dissimilar production methods. Until the mid-1930s, most commercial titanium white pigments were composite pigments from the plant in Fredrikstad or its competitor in Niagara Falls.[29] The global market for titanium white thus expanded throughout the 1920s, and the higher international market demand went hand-in-hand with Titan Co.'s new marketing strategy: a visual identity and graphic design program with official trademarks, letterheads, fonts, and mascots.

Fig. 8. Titan Co.'s logo from 1920. Kronos Titan's archive, Østfoldmuseene.

The mining company Titania AS and the manufacturer Titan Co. had turned to Greek origin myths both when selecting their company names and when developing their corporate identity; in Greek mythology, the Titans were the first gods at the beginning of time. The white product was represented by the figure of a Caucasian male nude (**fig. 8**), connoting the gigantic, nonhuman, and godlike. In the first company trademark from 1920, the giant hovers above a circular shape with small, island-like white silhouettes spread across it. It might seem like the figure has conquered the strata of the earth and been elevated into the stratosphere. He raises his strong arm in a victorious gesture as he clinches a piece of black, earthly stone as evidence of his conquest. His muscular body ascends into the eternal sphere of immaterial space, his gaze fixed upward and beyond.

In the image, the giant has freed himself from earthbound processes of decay and undergone apotheosis to become a kind of all-white god.

Fig. 9. "Titan: Turns black into white." Original drawing, unknown designer, 1920. Østfoldmuseene archive.

The white giant was chosen as Titan Co.'s logo, and in the archives of a local printing establishment in Fredrikstad he appears in an early advertisement, developed in 1920 for Norwegian and international markets (**fig. 9**). The original rectangular drawing has a large-scale format and a carefully composed design: the sharp line on the black background, the placement of the lettering, the positioning of the paint bucket, and the male figure's bent back are arranged to coincide with the proportions of the golden ratio. The composition shows the Titan god as he bends down, stretches out his arm, and reaches for one of several black children. He lifts the children and washes them in the bucket of paint, in a sort of total-immersion baptism. But their skin color is not all that changes through this transformation; their physical characteristics are also altered. Their curly hair is straightened and their lips thinned. The formal composition of the advertisement further suggests a temporal narrative; with a friendly and naïve facial expression, the black children willingly approach the paint bucket. The child who is freshly dipped in the white paint is pictured in the position of a newborn, as if the Titan has delivered the white baby and brought it into a new world. The climax of the temporal narrative is that the whitewashed children turn away from the bucket of paint and the giant. They do not pay attention to him anymore but appear empowered and confident as they move forward into the world. Their innocent expressions are replaced by happy smiles. The word "Approved" can be read underneath the racist illustration. This Titania advertisement circulated frequently in newspapers and magazines for three decades, from the early 1920s to the mid-1950s.[30] This can be seen as a grim example of what Anne McClintock calls commodity racism: "no pre-existing form of organized racism had ever before been able to reach so large and so differentiated a mass of the populace."[31]

Cheng, Davis, and Wilson define race as "a concept of human difference that established hierarchies of power and domination between Europe and Europe's 'others,' by classifying human subjects into modern/non-modern, civilized/primitive, white/nonwhite, and human/less than human binaries."[32] Kathryn Yusoff also connects the dichotomy of white/ nonwhite to modernist ideals of cleanness, order, and progress; in *A Billion Black Anthropocenes or None*, she claims that white is a symbol of arrival and black, of belatedness. "The construction of the human as such, as it pertains to origins," she writes, "is divided along with geologic strata into White and Negro as part of the differentiating discourse of race and time, in which Whiteness signals arrival and Blackness belatedness."[33] Correspondingly, Michael Taussig thinks along these lines when he critically explores the history of color in colonized and colonist landscapes. Pigment was a precious commodity in Europe during the early modern and modern period, he writes, but also—from a Western perspective—deeply antimodern. Taussig shows how Europeans perceived color as exotic, naïve, and antiprogressive.[34] David Batchelor theorizes such perceptions through the term *chromophobia*.[35] The visual narrative of black, naïve, and passive children being grabbed by the giant and transformed into white children who raise themselves up after being dipped in the paint points to a temporal dichotomy between the belated passive and the arrived progressive—moving forward and beyond.

This temporal dichotomy was at the time a well-known representation model in Western cultures, prominently displayed in the international exhibitions and world's fairs of the nineteenth and early twentieth centuries.[36] Such events supported imperial strategies by claiming to give evidence of how the indigenous population of the African continent needed European technology, information, and culture to evolve from so-called primitive to civilized societies. In 1908, the newly independent state of Norway (three years after the dissolution of the union with Sweden) established a committee to plan the 1914 Centenary Jubilee Exhibition celebrating the hundred-year anniversary of the Norwegian constitution and the separation from Denmark in 1814. The industrialist Sam Eyde, who a few years later became the co-owner of Titan Co., formed the planning committee together with other wealthy, powerful men.[37] The monumental exhibition in Frogner Park in Kristiania (today's Oslo) became the most visited public event in Norway in the twentieth century.[38]

Fig. 10. The Jubilee Exhibition in Frogner Park, Kristiania (Oslo), Norway, 1914. DigitaltMuseum.

Media historian Espen Ytreberg highlights several visitors' reactions to the lack of traditional Norwegian buildings and culture among the displays.[39] Instead of choosing traditional wooden architecture, the exhibition committee had selected a continental architecture that resembled what was appearing in international exhibitions—monumental, white buildings in an "antique style."[40] The committee's intent was to showcase Norway's most progressive endeavors, such as hydroelectric power industries (**fig. 10**). In the press, the Jubilee Exhibition in Frogner Park was compared to the "white cities" of the World's Columbian Exposition in Chicago in 1893 and the Franco-British Exposition in London in 1908: the "White City of Frogner" impressed visitors as soon as they entered the main gate leading into the exhibition area. According to Ytreberg, a common analogy was that a visit to the exhibition felt like a journey to another country or even a fairy-tale world.[41] The Jubilee Exhibition copied several well-known concepts from international fairs held in previous decades, including a replica of a native African settlement, identified as the "Congo village" and featuring African performers, which was a part of the exhibition's entertainment section (**fig. 11**).[42]

Fig. 11. Performers of unknown identity in the Congo village in Kristiania (Oslo), Norway, 1914. DigitaltMuseum.

The village represented a stark contrast to the ethos of industrial progress in the "white city." In an issue of the magazine *Urd* from 1914, a journalist ends a description of his visit to the Jubilee Exhibition by explaining how "we leave the black people's village with a merry feeling: it is lovely to be white, *white*!"[43] By building a Congolese village in Oslo in 1914, the exhibition committee clearly indicated the future they intended to be a part of: the European colonial era. In this prospect, vernacular buildings, indigenous knowledge, and local materials were exchanged for continental architecture, Western technology, and white, homogenous façades and surfaces. In global terms, Norway is not considered a conventional colonial power.[44] However, the planning committee's decision to project Norwegian culture into a progressive future of white, monumental architectural environments—with indigenous peoples of Africa as a backdrop of "belatedness"—must be considered an imported gesture of coloniality, as were the normalized racial tropes in the Titania advertisement. In the attempt to project a prosperous future for the young state, Norway placed itself on the side of white colonial powers.[45]

From Inconspicuous Modernity to Systemic Toxicity

Throughout the 1920s, more and more houses and interiors were painted with titanium white. One of the first traces of the paint in modern architecture was the interior of Josef Frank's Villa Beer in Vienna, completed in 1930. Ivo B. Hammer has identified the color pigment in some rooms as "an early type of titanium white, an opaque, white pigment," namely "KRONOS-titandioxide."[46] Titan Co. soon realized that the aesthetic connection between white and modern architecture could be utilized in its visual marketing strategies for external and internal house paint. During the 1920s and early 1930s, the traditional Norwegian wooden houses frequently featured in Titan Co.'s advertisements gave way to modern villas in the International style (**fig. 12**). Hammer proposes that it was "perhaps not mere coincidence" that Frank turned to titanium white:

> Josef Frank wanted the whiteness to appear as even, regular and "pure" as possible, in keeping with his idea of the colour of interior walls, which he saw as being a neutral, nondominant background allowing a free choice of objects—and their colours—in the room: flowers, pictures, carpets, curtains and furniture. The use of the highly opaque titanium white is the technical correlate of the aesthetic intention of having a regular "white" surface.[47]

Fig. 12. Modern White, 1920s and 1930s. Østfoldmuseene archive.

When modern architecture established white as the nondominant background par excellence, the color withdrew further into the inconspicuous realm. Furniture and objects were meant to be free from any background. The wall was not meant to be noticed. The white giant also withdrew further from sight and from thought, as visualized by the advertisement in which the Titan god baptizes the black children in white paint; the white children do not pay attention to the giant who is responsible for their transformation. Black children curiously gaze directly at the strange giant, but the white ones have their eyes set on the world ahead.

When the circulation of titanium white increased throughout the 1920s and 1930s, its invisibility arguably increased as well, and not only on a metaphorical level. When the chemical component titanium dioxide (that is, the origin of the titanium white pigment whose industrial manufacturing process was also patented by Farup in the early 1910s) was engineered into a coloring additive that maximized brightness, the chemical substance traveled from the increasingly unnoticeable surface of objects and environments into the very core of products. During the 1920s and 1930s, titanium dioxide was, as already stated, introduced as a filler, stabilizer, and colorant in metals, plastic items, concrete coatings, linoleum floors, shoe polish, cosmetics, printing ink, wallpaper, writing paper, photographic paper, and photographic film. The chemist who, in 1909, gazed through the microscope and captured painted surfaces in eight photographs could not have imagined that the very substance he was studying would later make photographs shine brighter.

Fig. 13. "Eventyret om svart til hvitt" [The fairy tale of black to white] directed by Robert Dahl (1956). Østfoldmuseene archive.

The business archive of Kronos Titan contains yet another material trace of TiO_2's increasing inconspicuousness, this time captured on 16 mm film (**fig. 13**). *Eventyret om svart til hvitt* [The fairy tale of black to white] was commissioned by Titan Co. and Titania AS and created by the film director Robert Dahl in 1956. In the planning phase of this filmed advertisement, the director might have asked himself a question: "How is it possible to make visible what is not meant to be noticed but exists all around us?" Dahl's answer was to yet again personify titanium dioxide as a god, but this time one that was both invisible and domestic. The film's narrative starts in an idyllic southern Norwegian landscape with white wooden houses. When the camera zooms in on a specific white house, a painter and a young housewife appear. The woman leans out of a window and comments on how bright the white paint looks. She asks the painter what kind of paint it is. "It's Kronos Titan white paint," he answers. In a cheerful tone, they converse about how well the paint covers and how durable it is. The housewife asks, "Tell me, Titan—doesn't that have to do with the old gods?" The painter responds that he doesn't know, but for him the paint is indeed divine. As the camera shifts from the exterior to the interior of the house, the woman starts singing as she puts a white kettle on the stove: "Titan, titan, titaaan… ." Suddenly a male voice can be heard: "Here I am!" She looks surprised: "Where?" She turns her head and gazes around her kitchen. "Good morning, here I am," the voice repeats. "Yes, but where are you?" she asks again with a giggle. "Here, for example, and here," says the divinity. "Yes, but who are you?" the woman asks. "My name is Titan, and I am everywhere," he answers, then demonstrates his presence by animating objects in her kitchen.

After passing from the kitchen through the living room, the young woman is seen entering the bathroom. Once again the Titan is heard: "[I'm in] the toothpaste and toothbrush, and your delicate underwear is also matted with TiO_2."

The Titan's male voice does not resemble that of a mighty god, for the voice of whiteness is soft and friendly, but the film's atmosphere certainly changes as the camera finds the woman in a white slip in the bathroom. After the male voice tells her that he even exists in her delicate underwear, she tries to lock the bathroom door to keep him out. She puts on a shower cap and covers herself with the shower curtain. Looking straight into the camera, she speaks with confidence: "Now, in any case, I've locked out the Titan."

But the voice returns the moment she thinks she is safe. We as viewers observe how she drops the sponge and trips anxiously back and forth on the white shower mat when the voice speaks yet again. There is no escape from the Titan.

In this filmed advertisement, the modern, white domestic space has turned into a Hitchcockesque scene for a psychological drama involving a predicament from which there is no escape. The film ends with the woman's realization that she cannot get away from the white spirit's voice or material presence. Her final words? "Then I'll just accept your presence." When the whitest white, which was initially only used in paint, was ubiquitously deployed in the environment as a colorant, stabilizer, and filler, the synthetic material withdrew further into the shadows of thought, most especially since this withdrawal *did not* move into the realm of pure invisibility. The chemical substance is not invisible as such—but is in fact dense and opaque—which is a particularly paradoxical kind of material inconspicuousness. Originating from absolute white, the chemical substance has the capacity to instigate absolute abstracted withdrawal at the same time that it renders a specific material form that radically transforms the aesthetics of a surface by the means of its opacity.

TiO_2 traverses the border between appearance and nonappearance in its very being as a *systemic material*; its original relation to the earth (the black ilmenite) is radically unsettled through technological processes. Farup's sulfate process transforms the earth's minerals into an unfamiliar state—hardly visible but not quite invisible, hardly material but not quite immaterial—which then merges the realms of visuality, materiality, and technology. In their very being, TiO_2 surfaces came to embody a new kind of inconspicuousness that is radically disconnected from their own earthly origin. The wide circulation of TiO_2 rooted *unhomeliness* in interior and exterior surfaces, creating a division between the materiality of the home and the homely. Importantly, this strange dialectic between inconspicuous withdrawal and dense impenetrability happens not only *on* surfaces; the mass circulation of TiO_2 epitomized a change in the epistemological status of surfaces as the substance was deployed in more and more ways in the environment. The TiO_2 surfaces in the young woman's house are not just like a coating, a skin, or an envelope *on* or *around* a building or body; they are neither entirely *between* different entities nor mediating like a membrane or tissue between different entities. TiO_2 surfaces challenge previous epistemological categories to which surfaces have belonged; they are both specific (yet inconspicuous) forms and environmental agents that circulate in our biological, material, and economic systems. With TiO_2, the surface came to exist not just *on* but also *with* physical objects and environments. The arrival of this unfamiliar "with-on" surface had again a paradoxical consequence; the uncanny layer soon withdrew into the habitual and familiar—because of its incomprehensibly wide circulation. Like the young woman in the filmed advertisement, we have no other choice than to adapt to the strange systemic material and to accept its presence.

One hundred years of mining for TiO_2 has irreversibly altered the local landscape of Sokndal, Norway. The environmental traces of mining modernism consist of a vast cut through the surface of the earth and a gray, artificial desert of mining waste. Approximately 13 million tons of ore are excavated every year in the open-pit mine, which results in the land deposit of mine waste growing by 2.7 million tons every year. The first such landfill, which was initiated in the early 1990s, now covers a whole valley (**fig. 14**). It will reach its limit in 2024, when the depth of the tailings will be 100 meters. The land deposit poses problems for local residents when its small particles are blown about by the wind. Even more serious problems occur deep down in the deposited mass. Due to the infiltration of rainwater, toxic trace metals like nickel, copper, and cobalt are washed into the local fjord, Jøssingfjorden, with a devastating effect on aquatic life. In 2019, a report recorded a total of 2,700 kilograms of nickel flowing out of the tailings dam.[48]

Fig. 14. The Titania land deposit which will reach its limit in 2024. Marte Johnslien, 2019.

The violent law of whiteness is not only accentuated by the white pigment; it *is* the pigment as such—an inconspicuous visual and material signature of modernism. Today, however, TiO_2 circulates in our material, economic, and biological systems in new forms. TiO_2 has yet again been transformed into a new, inconspicuous presence—this time at a nanoscopic scale, discernible only through the microscope. The pigment has undergone a transformation into a smart material claimed to be a so-called "green technology" for future sustainability. Today, TiO_2 nanoparticles can produce smog-absorbing building surfaces, self-cleaning windows, and antimicrobial coatings for laboratory use. Advertisements for TiO_2 by the Titanium Dioxide Manufacturers Association are posted on YouTube. In one example, while a futuristic, computer-generated city appears, a male voice declares, "The air turns cleaner as titanium dioxide paint and catalyst exhaust systems, destroy pollutants around us."[49] In a recent review of literature on building and construction materials containing TiO_2, the authors conclude that "TiO_2-based photocatalysis has proven to be a very promising advanced oxidation process for the depollution and cleaning of indoor and outdoor air, exhibiting unique advantages over conventional remediation technologies."[50] However, the boundary between sustainable development through technologically optimized solutions and toxicity is currently becoming progressively indiscernible. In 2020, new studies in leading journals in toxicology published results showing that nanoparticles of TiO_2 now are found in human organs and tissues.[51] In addition, TiO_2 particles in human lung cells are "altering two enzymes responsible for epigenetic modifications."[52] In 2019, the French government signed an order to ban TiO_2 in food beginning January 1, 2020. In 2020, new regulations for the classification of powdered TiO_2 were published in the Official Journal of the European Union. Beginning in 2021, warning notices for liquid and solid mixtures containing more than one percent TiO_2 were mandatory in all European Union member states.

From White to Earth

By following the canon of architectural modernism, we can suggest that the most toxic part of this story, today, is the familiarity that makes the dichotomy between the toxic and nontoxic indiscernible. The nontoxicity of titanium white secured its global success but materially and visually inscribed a latent toxicity of inconspicuous modernity into and onto the industrial products used in everyday life—products whose whiteness belies their embeddedness in many toxic production processes. This systemic surface needs its own preposition; “with” makes explicit a *connectedness*, in the sense that the preposition points toward something else (meaning “toward, by, near”) and “on” makes apparent its material, visual, and technological properties. The whitest white designates a site, a time, and also an ontological condition, as most of the world’s population now lives with-on white. How is it possible to deconstruct that which appears universal, modern, and transparent but still exists all around us? How might we disrupt the inconspicuous surface that strives for neutrality and withdrawal?

Fig. 15. *White to Earth, Lake Study no. 1*. Ilmenite, titanium dioxide, nickel oxide, rutile, and crystalline glaze on porcelain. Marte Johnslien, 2020.

A thick, opaque, and glossy layer with a spiky and dramatic texture in lurid green and blue colors with crystalline effects is added to a matte, pure white surface shaped as a container (**fig. 15**). The work *White to Earth, Lake Study no. 1*, is a material investigation of the properties of titanium dioxide in ceramic glazes. It was made by the Norwegian artist and researcher Marte Johnslien (coauthor of this article), who in this work has carefully investigated how temperature and temporality can force titanium dioxide to crystallize and become a texture on the surface of a clay object. The material essence of titanium white and titanium dioxide is thus obstructed by the very elements the systemic surface was designed to resist.

In their research collaboration, the authors of this article—visual artist and researcher Marte Johnslien and art and architectural historian Ingrid Halland—aim to combine methods and works in artistic research with research in the humanities. Through an interdisciplinary research design,

they have employed several methods in order to write this article: material experiments, archival research, analysis of primary sources, visual analysis, site fieldwork, co-writing, and critical studies in architectural history and theory. This article is the first output of two linked research projects: "TiO_2: The Materiality of White" and "TiO_2: How Norway Made the World Whiter," led by Johnslien and Halland and funded by the Norwegian Artistic Research Programme (DIKU) and the Norwegian Research Council. An early draft of the article was presented as the keynote lecture, "Material Withdraw: How Modernism Made the Surface Invisible," at the symposium "Crafts in a Digital Age" ["Kunsthåndværk i en digital tid"] at the University of Southern Denmark, January 20, 2022. The authors wish to thank the Aggregate *editors Meredith TenHoor and Jessica Varner and the members of the "Toxics" research cluster for their sharp and compelling critical responses. Key conceptual suggestions were also offered by Panagiotis Farantatos (assistant professor at Aarhus University). We also wish to thank our collaborators in the research projects: Janne Werner Olsrud (head of collections and exhibitions at the Norwegian Mining Museum), Hege Steen Langvik (curator at Østfoldmuseene), Marianne Løken (head of research at Østfoldmuseene), June Stuen (director at Dalane Folkemuseum), Olaug Økland (curator at Dalane Folkemuseum), Tonje Haugland Sørensen (University of Bergen), Finn Nesvold (Titania AS), and Marte Kristine Tøgersen (head of research at Titania AS).*

✓ Transparent Peer Reviewed

Ingrid Halland and Marte Johnslien, "'With-On' White: Inconspicuous Modernity with and on Aesthetic Surfaces, 1910–1950," *Aggregate* 11 (January 2023), https://doi.org/10.53965/CLXI6947.

*Transparent peer-reviewed

1 "Sammenliknet med en finere fransk oker viser titanfarge at praktisk samme lyse nyance en overlegen dekkevne ... med andre ord; titanfargens dekkevne er cirka fem ganger så stor som okerens." Notebook entry, 7 June 1910, signed "J.Bl," box "Norske titanverker 1910–1914," Peder Farup private archive, Norwegian Mining Museum, Kongsberg, Norway. ↑

2 One example of this impact is the essay "Ornament and Crime," by Adolf Loos, who probably drafted it in December 1909 or early January 1910. See Christopher Long, "The Origins and Context of Adolf Loos's 'Ornament and Crime,'" *Journal of the Society of Architectural Historians* 68, no. 2 (2009): 200–23, https://doi.org/10.1525/jsah.2009.68.2.200. ↑

3 With regard to the "death of the ornament," Long writes, "What has often been misunderstood is that [Adolf] Loos did not lose his faith in ornament, but rather in our capacity to make and use new ornament. The crime was not ornament, but the fact that so many failed to acknowledge the unavoidable truth: that ornament was losing its relevance in modern architecture and design." Loos thus "believed that ornament was dying and could not be

revived." Long, "Origins and Context of Adolf Loos's 'Ornament and Crime,'" 218. For more on the racial coding of this moment in Loos's work, see Irene Cheng, "Structural Racialism in Modern Architectural Theory," in *Race and Modern Architecture: A Critical History from the Enlightenment to the Present*, ed. Irene Cheng, Charles L. Davis II, and Mabel O. Wilson (Pittsburgh, PA: University of Pittsburgh Press, 2020), 134–52, https://doi.org/10.2307/j.ctv11cwbg7. ↑

4 Titanium dioxide has been studied in the context of the history of science, as well as within the field of technical conservation; see Nicholas Eastaugh, Valentine Walsh, Tracey Chaplin, and Ruth Siddall, *The Pigment Compendium: A Dictionary of Historical Pigments* (London: Routledge, 2004); Marilyn Laver, "Titanium Dioxide Whites," in *Artists' Pigments: A Handbook of Their History and Characteristics*, ed. Elisabeth West FitzHugh (Washington, DC: National Gallery of Art, 1997), 295–357; and B. A. van Driel, K. J. van den Berg, J. Gerretzen, and J. Dik, "The White of the 20th Century: An Explorative Survey into Dutch Modern Art Collections," *Heritage Science* 6, no. 1 (2018), https://doi.org/10.1186/s40494-018-0183-4. Marte Johnslien focused on the Norwegian history and the material properties of TiO_2 for her PhD in artistic research (Johnslien, "Circumstantial Sculpture. Reflection" [PhD diss., Oslo National Academy of the Arts, 2019]), which was also published as *White to Earth* (Oslo: ROM Forlag, 2020), in connection with the exhibition *Hvitt til jord*. Titania AS has self-published a few books and brochures to mark company anniversaries, including Halfdan Carstens, ed., *Titania I 100! 1902–2002: Jubileumsbok for Titania a/S* (Hauge i Dalarne: Titania, 2002); and Knut Immerstein, ed., *Titania A/S 90 år: 1902–1992* (n.p., 1992); Finn Nesvold, "Spor av jern. Drift på titanholdig jernmalm i Eigersund og Sokndal," Per Øyvind Østensen, ed., *Kulturvern ved bergverk 2006. Rapport fra et nasjonalt seminar i Egersund og Sokndal*, Norsk Bergverksmuseum skrift no. 34 (2006): 60–65; Finn Nesvold, *The Norwegian Titanic Iron Co, Ltd. Mining operations in Blåfjell 1863-1875* (Sokndal: Magma Geopark, 2006). In a paper presented at the Norwegian Mining Network in 2011, mining historian Frode Sæland presented an overview of the events that lead to the innovation of titanium white. Frode Sæland, "Titansaken – Peder Farup, Gustav Jebsen og innovasjonen titanhvitt 1907-1920," Per Øyvind Østensen, ed., *Kulturvern ved bergverk 2010: Rapport fra et nasjonalt seminar på Modum,* Norsk Bergverksmuseums skriftserie no. 47 (2011): 5–32. In an international context, David A. Hounshell and John K. Smith have written a chapter about Du Pont's production of TiO_2 in Germany: *Science and Corporate Strategy: Du Pont R&D, 1902–1980* (Cambridge: Cambridge University Press, 1988), 210–21. ↑

5 Le Corbusier quoted in Stanislaus von Moos and Margaret Sobiesky, "Le Corbusier and Loos," *Assemblage*, no. 4 (1987): 24–37, quote at 30. ↑

6 Barbara Klinkhammer, "Creation of the Myth: 'White' Modernism" (paper presented at the ninety-second ACSA Annual Meeting, Miami, Florida, 2004). ↑

7 "Health and safety problems related to lead white were discovered, leading to a ban or restriction (Geneva White Lead Convention) of the use of lead white for interior painting between 1905 and 1930 in most countries." van Driel et al., "White of the 20th Century." For a detailed history of color, see Philip Ball, *Bright Earth: Art and the Invention of Color* (Chicago: University of Chicago Press, 2003). ↑

8 Although the toxic lead white indeed is a bright white, titanium white is still significantly brighter. TiO_2 reflects back 97 percent of the light versus 93 to 95 percent for the lead whites. ↑

9 See, for instance, Martin A. Berger, *Sight Unseen: Whiteness and American Visual Culture* (Berkeley: University of California Press, 2005); Anne Anlin Cheng, *Second Skin: Josephine Baker and the Modern Surface* (Oxford: Oxford University Press, 2010); Dianne Harris, *Little White Houses: How the Postwar Home Constructed Race in America* (Minneapolis: University of Minnesota Press, 2013); Lesley Lokko, *White Papers, Black Marks: Race, Culture, Architecture*

(Minneapolis: University of Minnesota Press, 2000); Anna Neimark, "On White on White," *Log*, no. 31 (2014): 62–66; Brian O'Doherty and Thomas McEvillery, *Inside the White Cube: The Ideology of the Gallery Space* (Berkeley: University of California, 1999); Sally-Anne Huxtable, "White Walls, White Nights, White Girls: Whiteness and the British Artistic Interior, 1850–1900," *Journal of Design History* 27, no. 3 (2014): 237–55, https://doi.org/10.1093/jdh/epu024; Itohan Osayimwese, *Colonialism and Modern Architecture in Germany* (Pittsburgh, PA: University of Pittsburgh Press, 2017); Ernest Pascucci, "White Forms, Forms of Whiteness," *ANY: Architecture New York*, no. 16 (1996): 14–15, https://www.jstor.org/stable/i40084496; Jeff Werner, *Kritvit? Kritiska vithetsperspektiv i teori och praktik* (Lund: Studentlitteratur, 2021); and Mark Wigley, *White Walls, Designer Dresses: The Fashioning of Modern Architecture* (Cambridge, MA: MIT Press, 1995). ↑

10 Irene Cheng, Charles L. Davis II, and Mabel O. Wilson, eds., *Race and Modern Architecture: A Critical History from the Enlightenment to the Present* (Pittsburgh, PA: University of Pittsburgh Press, 2020), 6. ↑

11 Mark Wigley, "Chronic Whiteness," *e-flux*, Sick Architecture, November 2020. ↑

12 Cheng, Davis, and Wilson, *Race and Modern Architecture*, 4. ↑

13 Walter Mignolo, *Local Histories/Global Designs: Coloniality, Subaltern Knowledges, and Border Thinking* (Princeton: Princeton University Press, 2000), 22. ↑

14 Annette Lykknes, "The Chemistry Professor as Consultant at the Norwegian Institute of Technology, 1910–1930," *Ambix* 67, no. 3 (2020): 271–88, quote at 274, https://doi.org/10.1080/00026980.2020.1794697. Lykknes details how "the establishment of NTH coincided with the beginning of large-scale industry in Norway" and shows how "expectations were high as to what the Institute could contribute in terms of competence to establish new industries" (271). ↑

15 Lykknes, "Chemistry Professor as Consultant," 272. ↑

16 "Jeg anser dette som et bevis for, at vi i en fremtidig farvefremstilling kan anvende denslags avfaldsprodukter, som hittil ingensomhelst værdi har." Peder Farup, Report on "Titangult [titan yellow]," unknown date, ca. 1912–14, file "Beretninger og meddelelser fra Farup 1912– 4," Farup private archive. ↑

17 "Prof. Farup [har] varet beskjæftiget med at forfølge sit maal, av titanholdig avfald fra jerngruber resp. av titanholdige malme at kunne fremstille ett hvitt farvestof." From "Kort Rapport over expertise av Prof. Farups fremgangsmaade til fremstilling av hvite farver og svovelsyre, 1920," file "Peder Farups etterlatte papirer 1910–1930," Farup private archive. ↑

18 "Det mest interessante resultat var imidlertid at vi under disse arbeider fant, at ren titansyre, der som bekjendt er hvit, viste sig at være i besittelse av en meget stor dækkraft utrevet i olje." Gustav Jebsen, "Den Nye Norske Titanhvidt-Industri," *Tidsskrift for Kemi* 17, no. 5 (1920): 43. ↑

19 The raw materials for the production of titanium dioxide are the naturally occurring minerals ilmenite (titanium iron ore) and rutile. As a naturally occurring titanium dioxide, rutile is usually contaminated by iron oxides and therefore colored yellow, yellow-brown, and—as is the case for the ilmenite ore in southern Norway—pitch black. "My invention relates to the manufacture of coloring matter from titaniferous iron ores and consists in improvements in the manufacture of coloring matter of great covering power," Peder Farup declared in his first patent. "Manufacture of Coloring-Matter from Titaniferous Iron Minerals," US Patent Office, patent application filed March 11, 1910. ↑

20 "1) Dækkraften er større end hos saavel blyhvitt som zinkhvitt og dens dekkevne er minst dobbelt saa stor som zinkhvitt. 2) Den er hvitere end nogen av disse 3) den er ikke giftig og indeholder ingen skadelige bestanddele, saaledes at den er helt ufarlig… . 5) Dens motstandsevne mot indvirkning av sollys, vand, ferskt som salt, og

atmosferilier (syre og sure gasarter) er meget stor." From the document "Exposé over hvite olje-farver," June 4, 1918, folder "Beretninger og meddelelser fra Farup 1912–1914," Farup private archive. ↑

21 *Maud* was first launched in 1917. Roald Amundsen (1872–1928) became the first to successfully reach the South Pole (on December 14, 1911). His voyage with *Maud* through the Northeast Passage lasted for six years, but Amundsen never managed to reach the North Pole with his titanium white vessel. He was, however, the first scientifically verified explorer to reach the North Pole. This was in 1926, on the airship *Norge*. ↑

22 "A New Discovery in Paint: Kronos Titan White," advertisement brochure from 1919, Kronos Titan historical business archive, Østfoldmuseene – Fredrikstad Museum. ↑

23 "A New Discovery in Paint." ↑

24 "Once larger quantities became available after World War 1, [TiO_2] was incorporated into ready-made paint; in Europe the first formulation using titanium dioxide was registered in 1919 in Norway. The paint industry remained skeptical into the 1920s of the claims made of these pigments and the general public seemed to be unaware of them." "Titanium Dioxide White," in Eastaugh et al., *Pigment Compendium*, 364. ↑

25 See Arne Lie Christensen, *Den norske byggeskikken* (Oslo: Pax Forlag, 1995), 44–51; Knut Jonas Espedal, "From Stone to Norwegian Wood," *International Journal of Computational Methods and Experimental Measurements* 5, no. 6 (2017): 985–96; and Linn Borgen, "Stave Church Architecture as Sacred Memory: Technique, Materiality and Community in Medieval and Early Modern Norway" (PhD diss., University of Oslo, 2020). For a discussion on the Norwegian timber industry and prefabricated architecture, see Maryia Rusak, "Factory-Made: The Everyday Architecture of Moelven Brug, 1955–1973" (PhD diss., Oslo School of Architecture and Design, 2022). ↑

26 The art historian Tonje Haugland Sørensen's ongoing research at the University of Bergen traces the industrialization processes of the Norwegian timber industry. She argues that the steam-powered circular saw was a key condition that allowed for the global circulation of the popular "dragon style" of architecture in the 1880s and 1890s. See Tonje Haugland Sørensen, "A Villa for the World – Or the Role of the Dragon Style and Prefabrication in the Material Legacy of Colonialism," in *The Material Legacies of Nordic Empire, 1400–1979*, ed. Bart Pushaw and Thor J. Mednick (forthcoming); and "Traveling Dragons," in *Nordic Design in Translation: The Circulation of Objects, Ideas and Practices*, ed. Shona Kallestrop and Charlotte Ashby (Bern: Peter Lang, 2021). ↑

27 "Den nye norske Verdensartikel Titanhvitt," May 16, 1919, Kronos Titan archive, Østfoldmuseene – Fredrikstad Museum. The original Norwegian quote reads, "Den trænger fuldstændig ind i den bemalte flate og indgaar en slags organisk forbindelse med denne: derfor sprækker den ikke og skaller ikke av." ↑

28 Roland Barthes, "Soap-Powders and Detergents," in *Mythologies* (London: Vintage, 2009), 31. ↑

29 By 1945, 80 percent of the white pigments sold were titanium white. See van Driel et al., "White of the 20th Century." ↑

30 In Norway today, a racist advertisement from the 1920s is easily brushed off as a "product of its time." There are numerous examples of products relating to black color (food coloring, for instance), dirt (soap products), and "exotic" goods (such as cocoa) from the early 1900s up to the much too recent past that were marketed with derogatory imagery and text (including discriminating representations of the Sami people, people of color, and women). ↑

31 Anne McClintock, *Imperial Leather: Race, Gender and Sexuality in the Colonial Conquest* (New York: Routledge, 1994), 508. McClintock writes about the British Victorian era that "commodity racism became distinct from scientific racism in its capacity to expand beyond the literate,

propertied elite through the marketing of commodity spectacle." ↑

32 Cheng, Davis, and Wilson, *Race and Modern Architecture*, 4. ↑

33 Kathryn Yusoff, *A Billion Black Anthropocenes or None* (Minneapolis: University of Minnesota Press, 2018), 78. See also Denise Ferreira da Silva, *Toward a Global Idea of Race* (Minneapolis: University of Minnesota Press, 2007). For an artistic discussion on humanity's history and presence on our nature and landscape see Otobong Nkanga, *Otobong Nkanga: Uncertain Where the Next Wind Blows*, eds. Tone Hansen and Karen Monica Reini (Oslo: Heine Onstad Kunstsenter, 2021). ↑

34 Michael Taussig, *What Color Is the Sacred?* (Chicago: University of Chicago Press, 2009). ↑

35 David Batchelor, *Chromophobia* (London: Reaktion Books, 2000). ↑

36 Mabel O. Wilson details as much in her essential book *Negro Building: Black Americans in the World of Fairs and Museums* (Berkeley: University of California Press, 2012). For another critical analysis of colonialism, race, and world's fairs, see Raymond Corbey, "Ethnographic Showcases, 1870–1930," *Cultural Anthropology* 8, no. 3 (1993): 338–69, http://www.jstor.org/stable/656317. ↑

37 Anne Simonnæs, *Jubileumsutstillingen på Frogner 1914, en nasjonal feiring med internasjonale motiver? En kulturhistorisk undersøkelse av forarbeidet til industriutstillingen i Kristiania i perioden 1900–1914* (Master's thesis, University of Oslo, 2003), 40. ↑

38 "With an estimated 1.5 million visitors and 2.7 million unique visits over five months to 214 fair buildings housing some 5,000 exhibitors, the Oslo Centenary Jubilee Exhibition was dwarfed by the great European and U.S. fairs (Brinchmann, 1923). It had a comparably vast scale relative to the nation that hosted it, however, because Norway at that time had only some 2.4 million inhabitants. No major Norwegian event lasting more than a few days has attracted equally large crowds before or since. Moreover, virtually all the visitors to the Oslo Exhibition were Norwegian." Espen Ytreberg, "Networked Simultaneities in the Time of the Great Exhibitions: Media and the 1914 Oslo Centenary Jubilee Exhibition," *International Journal of Communication* 10 (2016): 5284–5303, quote at 5288, https://ijoc.org/index.php/ijoc/article/view/5073/1825. ↑

39 Espen Ytreberg, *En forsvunnet by: Jubileumsutstillingen på Frogner 1914* (Oslo: Forlaget Press, 2014), 85. ↑

40 "The exhibition committee was successful in its plans to use the pure, antique style that generally seemed majestic and continental. This could be perceived abroad and thus testify that Norway had placed itself on the industrial civilization scale" [Utstillingskomiteen fikk gjennomslag for sine planer om å benytte den rene, antikke stil som gjennomgående virket majestetisk og kontinental. Dette kunne oppfattes i utlandet og dermed vitne om at Norge hadde plassert seg på den industrielle sivilisasjonsskalaen]. Simonnæs, *En forsvunnet by*, 113. ↑

41 Newspaper article quotations from Ytreberg, *En forsvunnet by*, 81–85. ↑

42 For a discussion on the "Congo village" at the Jubilee Exhibition in Oslo in 1914, see Brita Brenna, "Negere på Frogner," in *Nordmenn i Afrika—Afrikanere i Norge*, ed. Kirsten Alsaker Kjerland and Anne K. Bang (Bergen: Vigmostad & Bjørke, 2002). ↑

43 Quoted in Ytreberg, *En forsvunnet by*, 326. The original Norwegian quote reads as follows: "vi forlater de sortes landsby besjælet av en gla følelse: Det er deilig at vi er hvite, *hvite*!" ↑

44 Norway's state policy of *norwegianisation* [assimilation], in force from 1851 until the 1980s, directed in particular toward the minority Sami and Kven ethnic groups, consisted of efforts to make the Sami relinquish their language and change the basic values of their culture and national identity. See Henry Minde, "Assimilation of the Sami—

Implementation and Consequences," *Aboriginal Policy Research Consortium International* (*APRCi*) 196 (2005). ↑

45 It is worth noting that the production of the entertainment section of the 1914 Jubilee Exhibition was outsourced to the British company European Attractions Ltd. Espen Ytreberg, "Et mediert nasjonsfellesskap," *Tidsskrift for Kulturforskning* 12, no. 2 (2013): 14, https://ojs.novus.no/index.php/TFK/article/view/625. ↑

46 Ivo B. Hammer, "White, Everything White? Josef Frank's Villa Beer (1930) in Vienna, and Its Materiality in the Context of the Discourse on 'White Cubes,'" *Built Heritage* 4, no. 1 (2020), https://doi.org/10.1186/s43238-020-00011-9. ↑

47 Hammer, "White, Everything White?" ↑

48 Morten T. Schaanning, Hilde Cecilie Trannum, Sigurd Øxnevad, and Kuria Ndungu, "Benthic Community Status and Mobilization of Ni, Cu and Co at Abandoned Sea Deposits for Mine Tailings in SW Norway," *Marine Pollution Bulletin* 141 (April 2019): 318–31, at 319. ↑

49 Titanium Dioxide Manufacturers Association, "Titanium Dioxide: Crucial for a Cleaner, Brighter and Safer World" (2018), video posted on YouTube, quote from 00:43, accessed April 16, 2022, at https://www.youtube.com/watch?v=IS6E9NeCDF8. ↑

50 A. I. Gopalan et al., "Recent Progress in the Abatement of Hazardous Pollutants Using Photocatalytic Tio(2)-Based Building Materials," *Nanomaterials* 10, no. 9 (2020), https://www.doi.org/10.3390/nano10091854. The authors explain further: "Detailed information has been well demonstrated by researchers based on the results achieved with generalized use of self-cleaning surfaces, which are intended to provide buildings with a long-time stable aesthetic appearance. In parallel, the capability of photocatalysis in cementitious materials has been established in laboratories, at pilot scales, and, more recently, with some specific in-field monitoring programs towards the reduction of the levels of urban pollution and related developments." ↑

51 M. B. Heringa et al., "Detection of Titanium Particles in Human Liver and Spleen and Possible Health Implications," *Particle and Fibre Toxicology* 15, no. 1 (2018), https://www.doi.org/10.1186/s12989-018-0251-7; Ruud J. B. Peters et al., "Silicon Dioxide and Titanium Dioxide Particles Found in Human Tissues," *Nanotoxicology* 14, no. 3 (2020), https://doi.org/10.1080/17435390.2020.1718232. ↑

52 Dhanya T. Jayaram and Christine K. Payne, "Food-Grade TiO_2 Particles Generate Intracellular Superoxide and Alter Epigenetic Modifiers in Human Lung Cells," *Chemical Research in Toxicology* 33, no. 11 (2020), https://doi.org/10.1021/acs.chemrestox.0c00331. The full conclusion reads as follows: "These experiments show that low, non-cytotoxic concentrations of food-grade TiO_2 particles lead to cellular responses, including altering two enzymes responsible for epigenetic modifications. This production of superoxide and change in epigenetic modifiers could affect human health following inhalation." ↑